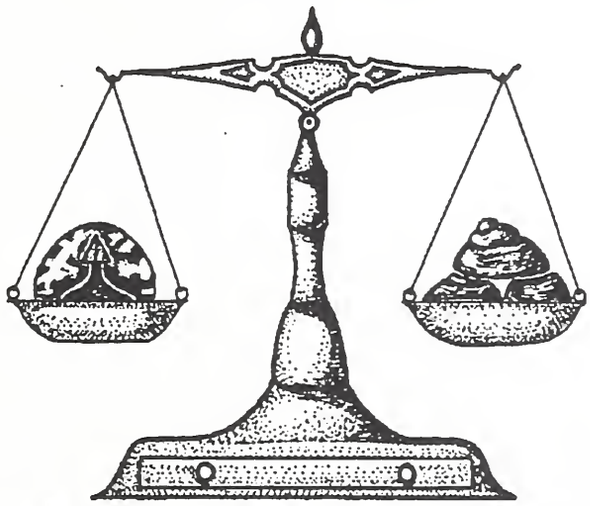
The Scale



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Vol. XVII October 1992

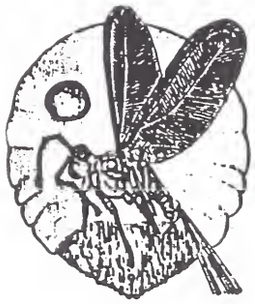
EDITORS' NOTES

The bulk of this newsletter has been supplied through the help of the folks at Virginia Polytechnic Institute and State University. Karen Veilleux continues her contract work of the included Coccoidea literature and now has a searchable data base. Karen is doing a wonderful job. Michael Kosztarab has prepared a work on Coccidology training and Mary Rhoades has updated us on activities in their lab. News from other labs and workers are always welcome.

NEWS FROM BELTSVILLE

It's been over a year since the Coccoidea collection has been moved to our present location. The new site has proved less cramped than the previous facility and we even have a small research area in the collection room. In addition to the room which houses the slide holdings, card files, and Coccoidea library, the extensive "dry" collection is held in new steel cabinets in an adjoining room. This facility has been specially designed to accommodate the fumes and vapors associated with preservatives of alcohol and dry collections. A refurbished building adjacent to the Coccoidea collection contains a lab for slide preparation and research and provides research offices for five scientists.

The past year has produced a spate of completed works form the lab. Earlier this year, "Systematic Analysis of *Acanthococcus* (Homoptera: Coccoidea: Eriococcidae) in the Western United States" (D. R. Miller & G. L. Miller, Trans. Am. Entomol. Soc. 118:1-106) was published. Description of a new species of *Acanthococcus* (D. R. Miller, Liu, & Howell) and a monograph of the Eriococcidae of the eastern United States (D. R. Miller & G. L. Miller) have both been accepted and should be published shortly. In addition, the description of a new genus of Kermesidae has been submitted for publication (D. R. Miller & G. L. Miller). Current research is concentrated on an undescribed species of Putoidae. (D. R. Miller & G. L. Miller) and Coccoidea phylogeny (Danzig, D. R. Miller & G. L. Miller). Through the assistance of Pennie Jennings, holdings in the collections continue to be organized. She has been instrumental in upgrading and making the library more user friendly and accessible. Years of use and abuse have taken their toll on the binders that held the literature.



SEVENTH INTERNATIONAL SYMPOSIUM
OF SCALE INSECT STUDIES ISSIS-VII
I S R A E L - June 1994

מדינת ישראל / משרד החקלאות

State of Israel / Ministry of Agriculture

AGRICULTURAL RESEARCH ORGANIZATION
THE VOLCANI CENTER

F I R S T C I R C U L A R

January 16, 1992

Dear Colleague,

The Seventh International Symposium of Scale Insect Studies (ISSIS-VII) will be held during the last week of June, 1994, in Israel.

On behalf of the Local Organizing Committee and the International Advisory Committee for ISSIS-VII, I am pleased to invite you to attend this Symposium. The Symposium is available to papers and posters on the following topics: Systematics, Faunistics, Biology and Ecology, Scale insect - Plant Interrelationships, Natural Enemies and Control.

Dr. Yair Ben-Dov
Secretary
Department of Entomology
The Volcani Center
P.O. Box 6, Bet Dagan 50 250, ISRAEL

SEVENTH INTERNATIONAL SYMPOSIUM
OF SCALE INSECT STUDIES ISSIS-VII
I S R A E L - June 1994

Future Circulars concerning the Symposium will only be sent to colleagues who will fill and return this Preliminary Registration Form by June 30, 1992. Please return the form to

Dr. Yair Ben-Dov, Department of Entomology, The Volcani Center,
P.O. Box 6, Bet Dagan 50 250 ISRAEL

PRELIMINARY REGISTRATION FORM

LAST NAME: .....

FIRST NAME: .....

ADDRESS: .....

.....

.....

COUNTRY: .....

TELEPHONE: .....

FAX No. : .....

I intend to present a paper/ a poster.

I am sending you a copy of the program for your use that was submitted for our symposium in Baltimore. It will be held on the 7th of December, 1992 beginning at 7:00pm. A room assignment will be made later when the official program is completed.

INFORMAL STERNORRHYNCHA SYMPOSIUM AGENDA

In Honor of Michael Kosztarab
for His Exceptional Life-Time Contributions to Coccidology

Organizer: P.L. Lambdin
Dept. Entomol. & Pl. Pathol. Univ. of Tennessee
Knoxville, TN 37901. [(615) 974-7135].

Co-Moderators:
Gary Miller, SEL\BARC, USDA/ARS
Beltsville, MD 20705, [(301) 504-5895]

and

M. L. Williams, Dept. Entomol., Auburn Univ.,
Auburn, AL 36849. [(205) 844-2574].

7:00 **Introduction**. Opening remarks to honor Dr. Michael Kosztarab. **P. Lambdin** and **J. O. Howell**. Dept. Entomol. & Pl. Pathol., Univ. of Tennessee, Knoxville, TN 37901. [(615) 974-7135]; Dept. of Entomol., Univ. of Georgia, Athens, GA 30602-2603. [(404) 542-2829].

7:10 Unique Adaptations in Coccinea. **M. Kosztarab**. Dept. of Entomol., V.P.I.&S.U., Blacksburg, VA 24061. [(703) 321-6773].

7:30 Update on Scale insect research in China. **T. X. Liu**,
Dept. Entomol, Univ. of Georgia, Athens, GA 30602 [(404) 542-2816].

7:42 Poinsettia host selection by the sweetpotato whitefly. **J. Price**, GCREC, 5007 60th St. East, Bradenton, FL 34203 [(813) 751-7636].

7:54 Euonymus Scale: Historical perspective and current distribution within urban landscapes. **P. B. Schultz**, V.P.I.& S.U., Hampton Roads, Agric. Exp. Sta., 1444 Diamond Springs Rd., Va. Beach, VA 23455 [(804) 363-3900].

8:04 Biological control of Homoptera in interior plantscapes. **S. Stauffer** and M. Rose. Dept. of Entomol., Biological Control, Texas A & M Univ., College Station, TX. 77843-2475 [(409) 845-7938].

8:16 Dermal ultrastructures found in the Sphaerococcinae. **H. J. Hendricks**. Dept. of Entomol., V.P.I. & S.U., Blacksburg, VA 24061. [(703) 321-6773].

8:26 Eriococcidae of the United States. **G. L. Miller** and D. R. Miller. SEL\BARC Bldg. 046, 10300 Baltimore Ave., Beltsville, MD 20705. [(301) 504-5895].

Break; (15 min.)

8:53 Life Histories: their value in aphid taxonomy and aphid control. **C. F. Smith**, North Carolina State University, Raleigh, NC 27695-7630.

9:18 Scale insect diversity in Central America. **M. L. Williams**. Dept. Entomol., Auburn Univ., Auburn, AL 36849.[(205) 844-2574].

9:30 The Scale-Aphid literature bibliography and indexing project and update. **K. J. Veilleux**. Dept. of Entomol., V.P.I.& S.U., Blacksburg, VA 24061. [(703) 321-6773].

9:40 A review of recent research of the San Jose scale. **D. G. Pfeiffer**. Dept. of Entomol., V.P.I. & S.U., Blacksburg, VA 24061. [(703) 321-4183].

9:50 Insights in *Pinnaspis aspidistrae* complex. **W. H. Reynolds** and M. L. Williams. Dept. Entomol., Auburn Univ., Auburn, AL 36849.[(205) 844-2574].

10:02 Resurrection of *Rugaspidiotus balachowski* with a description of a new species. **J. O. Howell**, Dept. of Entomol., Univ. of Georgia, Athens, GA 30602-2603. [(404) 542-2829].

10:14 Development and establishment of the Korean ladybug in Tennessee. **P. L. Lambdin** and J. F. Grant, Dept. of Entomol., Univ. of Tennessee, Knoxville, TN 37901. [(615) 974-7135].

Round Table Discussion. Business Meeting

End of Session.

VIRGINIA IS FOR LEAVERS

Mary H. Rhoades, VPI&SU

The play on words with the slogan "Virginia is for Lovers" seems appropriate considering almost everyone inhabiting the VPI Coccidology lab has left, if not physically, then at least to new assignments.

Gema was the first to go if you remember our news from last year. However, she didn't stay in Spain very long. It seems she missed someone in Germany, and moved there soon after she left here. She and her special someone, Ulrich Paar, were married this past August. As far as we know, Gema is still looking for employment there. Her dissertation research was published in the 16th scale insect bulletin in our series, and is titled: Biosystematics of the Family Dactylopiidae (Homoptera: Coccinea) with Emphasis on the Life Cycle of *Dactylopius coccus* Costa. Gema's address is: Gema Perez Guerra, Rudigerstr. 8, W 8000, Munchen 19, Germany.

July 1, 1992, Michael Kosztarab officially retired from VPI. But, you guessed it, he is still coming into the lab every day, and sometimes on weekends! Word from above is that this situation can continue until the department is able to hire a systematist to replace him (Is that possible?). The big retirement party was in June, and we were pleased that several coccidology colleagues from various parts of the eastern U. S. could attend. We had fun and we hope you did too.

The **Kosztarab Scholarship Fund** was established this spring by Michael and his family to provide financial assistance to graduate students who wish to study systematics at VPI. In recognition of the many years of service Michael gave to VPI, friends were asked not to give retirement gifts but to make a contribution to this scholarship fund. The generosity of Michael's family and many donors brought the total in the fund to over $13,500, making possible its endowment. Awards are not restricted to entomology department students; the only requirement is that the insect collection be used as the basis for their research. Please tell potential graduate students about this new source of financial aid.

Michael's retirement brought Mary Rhoades' retirement as well, at least from scale work. Although she and Michael are compiling a book on scale insects of northeastern N. America, she is working primarily for Bob Pienkowski on both basic research projects and departmental public relations assignments (displays, newsletters, media submissions). And looking for a job because her present position is now only half-time. You will see her at the Eastern Branch meetings in Williamsburg if you stop by the VPI recruiting booth.

The month after Michael retired, his current student, Harlan Hendricks, accepted a teaching position in Tennessee at a small college. Harlan hopes to finish his research and become Dr. Hendricks by the end of 1992. You can reach him at: Division of Natural Sciences, Bethel College, McKenzie, TN 38201. Phone, 901/ 352-1018. In case you are wondering, his wife, Beth, also got a job as a faculty member at Bethel College.

One scale employee is still on part-time payroll, Karen Veilleux, our cataloger. She has made a major contribution to this issue of The Scale with many new literature records on scales.

Although the VPI Coccidology lab may officially be disbanded, with Michael working every day and Mary occupying her regular space there (because there is no other space to be had), things don't seem too different. You can still reach Michael and Mary at the same phone numbers and addresses, and Mary at the userid on BITNET of KOSZY at VTVM1.

Addendum. Steve Bullington, who graduated from VPI in 1978, is now working with K. C. Kim at Penn State. His address is: The Frost Entomological Museum, The Pennsylvania State University, University Park, PA 16802.

Training in Coccidology
By Instructors in the United States

Michael Kosztarab
Virginia Polytechnic Institute & State University
Blacksburg, VA 24061-0319

Specialized courses in coccidology must have been taught by colleagues in other parts of the world, but to date I have no specific information on them. Courses in coccidology were taught in the United States at several institutions during the early decades of this century. The economic importance of Coccinea as pests in the USA became obvious with the accidental introductions of the cottony cushion scale, San Jose scale, white peach scale and others. Because Coccinea are remarkably different in structure from other insects and cryptic, special knowledge is required to collect, preserve, prepare slides, and identify them. Alvah Peterson, who took Alex D. MacGillivray's coccidology course at the University of Illinois in the 1910s, gave me some information on MacGillivray's course.. The course included basic instruction on collecting, mounting and identifying scale insects to species. The notes used in the course resulted in a book (MacGillivray, 1921).

D. Elmo Hardy taught a course in coccidology 3 or 4 times in the 1950's. John (Jack) W. Beardsley took it over after 1963 at the University of Hawaii. When Jack Beardsley learned about my efforts to put together a course syllabus on the subject, he graciously sent me his printed handouts. The late Howard L. McKenzie also taught such a course at least twice at the University of California at Davis. He included a compilation of a collection of specimens collected in the area, probably for one graduate credit. As least two of the students taking that course, Douglass R. Miller and Roberto H. Gonzalez, became coccidologists. My own effort started in 1969 when I offered a "Special Study" course in Coccidology to five graduate students and two technicians here at VPI & SU. This was a 4 credit course that included 2 lectures and 6 lab hours per week for a 10 week period during the Spring Quarter of 1969. The 3-page course description and the 26-page introductory handout included the major sources of literature for 20 families to be covered with the major genera in each family. Collecting, preservation, and mounting techniques were also included.

As a special course requirement, each of the five students had to survey about 1/5 of the Virginia Polytechnic Institute & State University campus grounds to collect their own specimens and identify the host trees and shrubs in that area. They were then required to preserve, slide-mount, and identify the scale insects to species. Each student was provided a 3-page printed list of the campus trees and shrubs and a blueprint of the campus grounds to be surveyed. Students had to mark on the blueprint the location of each tree and shrub examined, and designate them with a number, and

give the names of the scale species found on each host. In addition, each student had to prepare a pictorial key to the scale insect families in North America. The latter project initiated a publication (Howell & Williams, 1976). The course apparently was successful. Two of the students that took the course are still working and publishing on scale insects. The course was repeated once more with fewer students. Participants have taken a number of collecting trips, one as far as southern Florida.

In sharing with others my experience in graduate training in coccidology, I gave a talk (with a 6-page hand out) on this subject at the Third Symposium on Scale Insect Research in Los Angeles, California on November 29, 1971. I thought that my own graduate students working on coccidological research projects could benefit from the ideas of my colleagues working at the USDA Systematic Entomology Laboratory in Beltsville, MD, and at the University of Maryland. Therefore, the consensus was reached with my colleagues and the graduate students to organize weekend field trips and informal gatherings that would allow the exchange of ideas and skills. The first such trip was to Seashore State Park at Virginia Beach on May 8-9, 1971 with 11 specialists and their families attending. Despite the rain about 50 species of scale insects were collected. The rainy weather, however, gave us an opportunity for lively professional discussions under a large tent. The trip was a success and the participants voted to hold more such collecting trips.

The next trip was held during September 17-19, 1971 at the Virginia Federation of Garden Clubs, Nature Camp. This was near Vesuvius, Virginia in the George Washington National Forest, close to the Blue Ridge Parkway. Besides the 15 coccidologists, 17 other persons, including family members, attended. During an informal session each participant reported on their research activities and shared their specialized knowledge. Postcards were sent to a number of colleagues who worked on scale insects, but were unable to attend.

The third coccidology field trip was held April 21-23, 1972 at Presquile National Wildlife Refuge, on a man-made island in the James River near Hopewell, Virginia. This was another ecologically unique area that was previously unexplored for scale insects. Paris Lambdin and Dale Pollet assisted with the organization. Lists of the collected insects were printed in the April 28 and May 5 1972 issues of the Cooperative Extension Service Reports. Similar collecting trips with student participation were organized during some of the coccidology national symposia wherever these were held (e.g. Los Angeles, and New Orleans).

Dug Miller and John Davidson taught a graduate course in coccidology for five students (including W. F. Gimpell and Manya B. Stoetzel) at the University of Maryland in 1971-1972. Miller developed a two-volume syllabus with condensed descriptions of all families. It was a 2-credit lecture course. I realized that my own

future coccidology courses could be made more comprehensive if it involved more specialists as instructors, with each treating one or more families in which they were knowledgeable. Some colleagues learned about my earlier course offering at VPI & SU and I received a request from workers in California to offer such a course for a broader audience than graduate students at my university. I presented the request to my colleagues Dug Miller and John Davidson for a possible joint undertaking. After receiving enthusiastic support for the idea, we agreed to offer such a comprehensive course at the University of Maryland. This arrangement cut the cost of the course because local specialists from both the University and the USDA Systematic Entomology Laboratory could participate as instructors. There were at least 4 such persons at that time, thus saving on extra housing costs and travel expenses. We were able to take advantage of the excellent instructional equipment (e.g.., phase contrast video-microscopy) available at the university and the low cost dormitory housing. The Systematic Entomology Lab also provided the basic literature and slide mounted scale insect specimens needed for such a course. In the beginning, guest lecturers were also invited from Alabama, Georgia and Tennessee. Later, to reduce the cost of the course, only two instructors outside Maryland were invited.

Between 1974 and 1991 the "Coccidology Training Sessions", as they were called, were offered six times at an average interval of three years. These courses covered the scale insects of economic importance in the continental United States. Each time, a collecting trip on the University of Maryland grounds was held. Occasionally a tour to the USDA Systematic Entomology Lab and the Smithsonian Institution was also organized. A special lab session by Richard F. Wilkey on the mounting techniques and preservation methods was always offered. The course was coordinated by John Davidson and Dug Miller. Beside the three instructors mentioned, others who participated were: V. Blackburn, J. O. Howell, P. L. Lambdin, S. Nakahara, D. M. Odermatt, M. B. Stoetzel, M. L. Williams and M. Kosztarab. D. Rosen gave a lecture on biological control and J. Saunders on chemical control of scale insects in one session. A welcoming mixer opened the session, while an evening banquet closed it. A three-volume syllabus (not available for purchase) also, many research articles and bulletins, and a slide-mounting kit were provided to the registrants. The number of participants ranged from 17 to 24 and involved 5 to 9 (named earlier) instructors. Foreign students that took the course have come from China, Israel, Mexico, New Zealand, South Africa, and the Canary Islands.

A request was received to extend coccidology training to an even broader audience. Six instructors (J. A. Davidson, W. F. Gimpel, M. Kosztarab, D. R. Miller, S. Nakahara, M. B. Stoetzel) organized the first workshop on scale insect identification on October 1, 1975 at the 47th Eastern Branch Annual Meeting of the Entomological Society of America (ESA) in Philadelphia, PA. Dug Miller moderated the workshop. Participants were provided with two syllabi of 75 and 17 pages. The workshop was an

outstanding undertaking and rated as first class by Director Lloyd Knutson at USDA. Based on his suggestion the workshop was repeated for an even larger audience as a half day session at the ESA National Meetings at Honolulu, Hawaii, in 1976. Dug Miller produced the syllabus, with contributions from each instructor. The same basic format was used as for the 1975 ESA Eastern Branch meeting. A collecting trip was organized in the Honolulu area.

I received a request from D. M. Caron, Chair of the ESA Eastern Branch Program Committee, to organize a symposium on the "Status of Scale Insects of Forest Trees" for the Eastern Branch Meeting held in Boston, MA, on September 14, 1977. I did so with four other specialists: E. J. Duda, D. R. Houston, A. H. Mason, and M. S. McClure. The symposium provided an opportunity to discuss scale insect-tree disease interactions, which was a major concern in beech forests both in the United States and in Europe. Thirty-nine persons attended. I was also asked to organize and moderate a workshop on scale insects at the 23rd Southern Forest Insect Work Conference held at VPI & SU in Blacksburg, VA, during August 20-23, 1978. Specialists who participated in the workshop were A. B. Hamon, J. O. Howell, M. Kosztarab, P. L. Lambdin, D. R. Miller and J. A. Weidhaas.

On request of the director at the Institute of Agricultural Entomology of the University of Naples, a course was taught on "Scale Insects of Plant Quarantine Importance in the Mediterranean Area" in 1986 at Portici, Italy. The nine week course (April 21-June 21) was taught to 24 seniors, graduates students, and some staff members at the institute and dealt with 12 families, and about 100 species. My lectures or parts of them were usually translated to Italian by Donatella Battaglia or Gennaro Viggiani for the benefit of some students. I was fortunate in being able to work at the Institute. It has one of the oldest scale collections in the world and can list many coccidologists, such as A. Berlese, F. Silvestri, G. Leonardi, and V. Lupo, E.Tremblay, G. Viggiani and A. Tranfaglia. The newer generation of specialists includes: the systematists S. Marotta and F. Iaccarino; also pheromone workers such as G. Rotundo, R. Giacometti; and workers of chalcid parasites of scales, such as D. Battaglia, A. Garonna and S. Laudonia.

While teaching this course, I was asked to also teach a 4 day long coccidology course for Italian administrators and researchers in entomology. I did so, and was pleased to meet a number of famous Italian workers during the sessions. My two coccidology courses offered in Portici also attracted two workers from outside Italy. One person came from Spain, while another one came from Greece. The use of printed handouts, color slides and overhead projections helped overcome most language barriers. Interested students were instructed in the laboratory on slide mounting techniques. Large numbers of our VPI & SU research bulletins on Coccinea were shipped ahead of time and distributed to students taking the two courses. I had an enthusiastic group,

and a number of the students in the two courses since kept up with the Coccinea and published a number of papers on them.

The participants of the two courses had an opportunity to extend their coccidology training by staying over in Portici for the Fifth International Symposium of Scale Insect Studies (ISSIS-V) that followed during June 24-28, 1986. The planning of these events close together was possible through the foresight of Director Viggiani and his able faculty.

Michael L. Williams of Auburn University, Alabama has twice taught Coccidology as a "Special Topics in Entomology" course in their Department of Entomology. During the Fall and Winter Quarters of 1985-86 he taught it as a two-quarter course to three graduate students, two of which are still active in the field, and in the Spring Quarter 1992 he offered the course to a graduate student and one senior-level undergraduate. Each time the course consisted of lectures on the systematics, biology, and ecology of all the scale insect families and laboratories on microslide preparation and identification to the species level. A collection was required and several collecting trips were taken.

Michael Williams also taught Coccidology as a visiting professor at the Universidad del Valle in Guatemala City and the Escuela Agricola Panamericana in Zamorano, Honduras during 1990. Each course lasted about one month and involved lectures and laboratories in preparation and identification of scale insects with emphasis on the Central American fauna. Each school is developing a scale insect collection now as a result of training students, staff and professors at the two schools and both are collaborating with M. Williams to inventory the scale insects of their respective countries.

I am pleased to report that Paris Lambdin is also offering a coccidology course that is taught at the University of Tennessee for graduate students. It is being taught for 2 graduate credits during the winter semester on an alternate year basis.

It is the consensus among coccidologists that after 6 successful offerings at the University of Maryland, the Coccidology Training Sessions should continue as long as there is enough interest in the subject.

This summary will not be complete without mentioning the importance of graduate level training of qualified individuals in coccidological research that results in Master of Science and/or Doctor of Philosophy degrees, also provides major publications in this field. Almost all the senior researchers, mentioned in this report and our predecessors contributed to such graduate training. In a follow-up report I shall attempt to share my experience in this field.

ACKNOWLEDGMENTS

This paper was expanded with records and suggestions received from the following colleagues: John W. Beardsley, University of Hawaii, Honolulu, Hawaii; John A. Davidson, University Maryland, College Park, Maryland; Douglass R. Miller, Systematic Entomology Lab, USDA, Beltsville, Maryland; Paris L. Lambdin, University of Tennessee, Knoxville, Tennessee; Michael L. Williams, Auburn University, Auburn, Alabama; and at VPI & SU Harlan Hendricks and Mary Rhoades. Raymond J. Gill, California Department of Food and Agriculture, Sacramento, California reviewed the manuscript.

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Howell. J. O. and M. L. Williams. 1976. An annotated key to the families of scale insects (Homoptera: Coccoidea) of America, North of Mexico, based on characteristics of the adult females. Ann. Entomol. Soc. Amer. 69)2): 181-89.

MacGillivray, A. D. 1921. The Coccidae, Scarab, Urbana, Illinois. 502 pp.

GIOVANNI DE LOTTO
1912 - 1990

Mr. G. De Lotto, one of the eminent taxonomists of scale insects since the 1950's, died on August 19, 1990, in Siderno, Italy.

Giovanni De Lotto was born on 1912 in Venice, Italy. In 1930 he moved to the former Italian colony of Eritrea, and was engaged with various entomological projects. From November 1950 to April 1963 he worked at the National Agricultural Laboratories (formerly Scott Agricultural Laboratories), Ministry of Agriculture, Nairobi, Kenya, where he studied the taxonomy of African Coccoidea. In 1963 he joined the Plant Protection Research Institute, Pretoria, South Africa, and proceeded with his excellent studies on taxonomy of scale insects, at the National Collection of Insects. In 1979 he retired from his post in South Africa, returned to Italy and resided in Siderno, Regio Calbria.

His biography and List of Publications, will be published by us in the near future.

YAIR BEN-DOV
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AGATINO RUSSO
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CLARE FRANCES MORALES (nee Butcher)
1946 - 1991

The sudden, unexpected death of Clare on Tuesday 6 August has stunned her friends and colleagues. Clare grew up in the Hawkes Bay, and had an early interest in insects and spiders. Following undergraduate work at Otago University, she went to Lincoln College where she gained a Diploma in Agricultural Science with thesis work concerning bacterial and protozoan diseases of insects. In 1975 she came here to MARC, joining the biological control group of the then entomology division as a technician. After a few years she joined the Diagnostic Station of MAF which was based here, which allowed her to pursue her love of identifying insects.

1979 was a significant year for Clare. She gained her MSc (Hons) degree from Auckland University for her research on the life history and biology of a staphylinid (rove beetle) which lived in pastures. In August she joined our Systematics - Entomology section as the scientist responsible for systematic research in Hemiptera (scale insects, aphids and the true bugs).

Clare chose to specialise on scale insects - insects of economic and environmental significance, but an important group not studied by many because of their taxonomic challenges. After an number of years she decided to pursue a PhD study, and she worked on the family Margarodidae (giant scales). Imperial College, University of London awarded her a PhD in 1990, as a result of her studies. Some of these giant scales are notable for the abundant

production by their immature stages of honeydew, a sugary secretion attractive to foraging bees and other insects. Accumulating on the host plants, it becomes a substrate for the growth of conspicuous sooty moulds.

Her PhD work formed the basis of her Fauna of N.Z. contribution of Margarodidae published just a few months ago as number 21 in the series. She was proud that her contribution was the first in the series to be published with a new cover design and with a popular summary in Maori.

Clare's work achieved international recognition and was highly regarded amongst her peers. Last year at the 6th International Symposium on Scale Insect Studies in Cracow, Poland her poster presentation on cladistic analysis of margarodid phylogeny was awarded a commendation medal.

Clare was a dedicated scientist, who demanded very high standards of herself, she was a strong supporter and participant in the PSA and the DSIR Women's Network. She was a battler for causes, always ready to advocate changes to eliminate anything that was seen as discrimatory or unfair.

We grieve the loss of a friend and colleague.

Farewell Clare, Farewell.

Trevor Crosby

Dear Dug:

Thanks for sending the latest issue of "The Scale." I haven't sent you any of my references recently (since 1988) so I enclosed this bibliography for possible inclusion in the next volume.

All the best,

Mark McClure

List of Publications - Mark S. McClure

McClure, M.S. Nitrogen fertilization of hemlock increases susceptibility to hemlock woolly adelgid. J. Arboriculture 17:227-230.

McClure, M.S. 1991. Density-dependent feedback and population cycles in Adelges tsugae (Homoptera: Adelgidae) on Tsuga canadensis. Environ. Entomol. 20:258-264.

McClure, M.S. 1990. Cohabitation and host species effects on the population growth of Matsucoccus resinosae (Homoptera: Margarodidae) and Pineus boerneri (Homoptera: Adelgidae) on red pine. Environ. Entomol. 19:672-676.

McClure, M.S. 1990. Role of wind, birds, deer, and humans in the dispersal of hemlock woolly adelgid (Homoptera: Adelgidae). Environ. Entomol. 19:36-43.

McClure, M.S. 1990. Coevolution of armored scale insects and their host plants: Speciation processes. pp. 165-168. In D. Rosen (ed.) Armored Scale Insects: Their Biology, Natural Enemies and Control. Elsevier Science Publishers, The Netherlands.

McClure, M.S. 1990. Ecology: Habitats and hosts. pp. 285-296. In D. Rosen (ed.) Armoured Scale Insects, Their Biology, Natural Enemies and Control. Elsevier Science Publishers, The Netherlands.

McClure M.S. 1990. Host relationships: Impact on host plants. pp. 289-291. In D. Rosen (ed.) Armored Scale Insects, Their Biology, Natural Enemies and Control. Elsevier Science Publishers, The Netherlands.

McClure, M.S. 1990. Patterns of host specificity. pp. 301-303. In D. Rosen (ed.) Armored Scale Insects, Their Biology, Natural Enemies and Control. Elsevier Scinece Pbulishers, The Netherlands.

McClure, M.S. 1990. Patterns of temporal and spatial distribution. pp. 309-314. In D. Rosen (ed.) Armored Scale Insects, Their Biology, Natural Enemies and Control. Elsevier Science Publishers, The Netherlands.

McClure, M.S. 1990. Seasonal history. pp. 315-318. In D. Rosen (ed.) Armored Scale Insects, Their Biology, Natural Enemies and Control. Elsevier Science Publishers, The Netherlands.

McClure, M.S. 1990. Influence of environmental factors. pp. 319-330. In D. Rosen (ed.) Armored Scale Insects, Their Biology, Natural Enemies and Control. Elsevier Science Publishers, The Netherlands.

McClure, M.S. 1990. Life-tables, models and population dynamics. pp. 331-337. In D. Rosen (ed.) Armored Scale Insects, thier Biology, Natural Enemies and Control. Elsevier Science Publishers, The Netherlands.

McClure, M.S. 1989. Biology, population trends, and damage of Pineus boerneri and P. coloradensis (Homoptera: Adelgidae), on red pine. Environ. Entomol. 18:1066-1073.

McClure, M.S. 1989. Importance of weather to the distribution and abundance of introduced adelgid and scale insects. Agricultural For. Meterorol. 47:291-302.

McClure, M.S. 1989. Evidence of a polymorphic life cycle in the hemlock woolly adelgid, Adelges tsugae (Homoptera: Adelgidae). Ann. Entomol. Soc. Amer. 82:50-54.

McClure, M.S., C.G. Merrill and D. Souto. 1989. Hemlock woolly adelgid control in forests using foliar sprays applied by mist blower. Insecticide and Acaricide Tests 14:321.

Douglas, S.M. and M.S. McClure 1988. New integrated approach for controlling X-disease of stone fruits. Bull. Conn. Agric. Expt. Sta. 854: 10 pp.

McClure, M.S. 1988. Fletcher scale control on Taxus using foliar sprays in Autumn. Insecticide and Acaricide Tests 13:365-366.

McClure, M.S. 1988. Winter oil spray to control Fletcher scale on Taxus. Insecticide and Acaricide Tests 13:366.

McClure, M.S. 1988. Hemlock woolly adelgid control using foliar sprays. Insecticide and Acaricide tests 13:378.

McClure, M.S. 1988. Hemlock woolly adelgid, Adelges tsugae Annand, (Homoptera: Adelgidae) may also attack spruce (Abstr.) Proc. Intern. Congr. Entomol. IVIII:440.

Recent Literature

Ahn, S.B., Cho, W.S., Lim, S.E., Kim, T.J., Lee, M.H. & Choi, K.M. 1990. Banana insect pest species and their damage in the vinyl house on Cheju Island. Korean Journal of Applied Entomology 29(1):6-13; ill. (In Korean, English abstract)

Pseudococcus comstocki among the insect pests discussed.

Al-Azawi, A.F. 1986. A survey of insect pests of date palms in Qatar. 4(2):247-266; ill. (In English, Arabic abstract)

Among 11 insect pests found, three were scales: Parlatoria blanchardi, Asterolecanium phoenicis and Pheonicoccus marlatti.

Ali, R. & Ahmed, S.U. 1990. A preliminary report on the mealy-bug Maconnellicoccus sp.) and Tukra disease of mulberry. Bangladesh Journal of Zoology 18(1):123-124.

Brief description of mealybugs; damage described; biology.

Allender, W.J. & Beattie, A.C. 1991. Determination of petroleum oil deposits on Citrus sinensis (L.) Osbeck leaves. (Australia) Pesticide Science 31:133-139.

Improved method of spraying oil on citrus leaves described; Chinese wax scale mortality determined.

Alstad, D.N. & Corbin, K.W. 1990. Scale insect allozyme differentiation within and between host trees. Evolutionary Ecology 4(1):43-56.

Allelic frequencies and genotypic distributions in three polymorphic enzyme systems demonstrated genetic differentiation over extraordinarily short distances in a population of black pineleaf scale insects infesting ponderosa pine trees. A hierarchical analysis of the population genetic structure showed significant differences between demes on different twigs within individual host trees, between demes on neighboring trees, and between demes in pine plots on adjacent city blocks. Allelic frequencies at a malic enzyme locus were associated with deme-to-deme variation in ecological correlates of insect fitness, suggesting adaptive hypotheses about the causes of population subdivision.

Angeles Martinez, M. 1988. Saccharicoccus sacchari (Homoptera: Coccoidea, Pseudococcidae), Sugarcane mealybug: incorrect use of synonymy. (Saccharicoccus sacchari (Homoptera: Coccoidea, Pseudococcidae), chincheharinosa rosada de la cana de azucar: uso incorrecto de su sinonimia.) (Cuba) Revista de Proteccion Vegetal 3(2):128-131; ill. (In Spanish, English abstract)

Synonymy reviewed.

Angerilli, N.P. D. 1990. 3.5.3 Chemical Control of Males. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 409-411. (World Crop Pests.)

Discussion of problems encountered when trying to use this method; concludes male control is not a good method for San Jose scale on apples in British Columbia, but may be acceptable elsewhere.

Argyriou, L.C. 1990. 3.9.5 Olive. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 579-583. (World Crop Pests.)

Diaspidids are very destructive pests of olive; 60 species recorded, with Parlatoria oleae and Aspidiotus nerii the most widespread; all plant parts attacked; control of scales must be coordinated with control of Dacus oleae (olive fruit fly) and Prays oleae (olive kernel borer); chemicals are commonly used and have sometimes resulted in outbreaks of scale pests.

Arias-Reveron, J.M. 1990. Notes on natural enemies attacking Lepidosaphes species [Homoptera: Diaspididae] associated with Citrus in Costa Rica. Entomaphaga 35(2):301-303. (In English, Spanish & French abstract)

Lepidosaphes beckii and L. gloveri are associated with citrus, but are not considered serious pests in Costa Rica; natural enemies include Aphytis sp., Pentilia discors and Zagloba beaumonti.

Avasthi, R.K. & Shafee, S.A. 1989. Key to genera and records of some species of Coccinae (Homoptera: Coccidae) from India. Journal of the Bombay Natural History Society 86(3):468-471.

25 genera of Coccidae from India; records of 6 species of Coccinae are given; key to Indian genera of Coccinae given, based on adult females.

Azam, K.M. & Babu, T.R. 1990. Status and management of grape mealybug Maconellicoccus hirsutus (Green) in Andhra Pradesh, India. In Monitoring and Integrated Management of Arthropod Pests of Small Fruit Crops. Bostainian, N. J., Wilson, L. T. and Dennehy, T. J., Eds. Andover, NH: Intercept Ltd. 231-237.

Serious pest of grapes in India; discussion of biology, chemical control, biological control, and mechanical control.

Babu, T.R. & Azam, K.M. 1987. Studies on biology, host spectrum and seasonal population fluctuation of the mealybug, Maconellicoccus hirsutus (Green) on grapevine. Indian Journal of Horticulture 44(3-4):284-288.

Family: Pseudococcidae; polyphagous; infests more than 125 plant species; distributed in Oriental and Australian, Palearctic and Ethiopian realms.

Bach, C.E. 1991. Direct and indirect interactions between ants (Pheidole megacephala), scales (Coccus viridis) and plants (Pluchea indica). (Hawaii, U.S.) Oecologia 87:233-239.

Scale population densities, scale mortality rates, and plant performance were studied on control host plants with ants, and host plants from which ants had been removed; plants with ants present had significantly greater scale population densities and scale reproductive rates; P. megacephala removes predatory coccinellid larvae; host plants from which ants had been removed had significantly higher degrees of honeydew accumulation, which resulted in greater colonization by sooty mold and greater rates of leaf death and abscission; ants also removed herbivorous lepidopteran larvae from plants.

Badmin, J. 1990. First records of horsechestnut scale in Kent. (Great Britain) Bull. Kent Field Club (35):44-45.

Pulvinaria regalis, a woolly scale attacking limes and sycamore trees; polyphagous; specimens found on Laurus nobilis; damage described.

Baerg, W.J. 1947. The biology of the maple leaf scale. Bulletin. Univ. of Arkansas (No. 470):14 pp.

Pulvinaria acericola; found on Sassafras variifolium, Acer pennsylvanicum, A. dasycarpum, A. saccharinum and Cornus florida; natural enemies include Coccophagus fraternus, C. lecanii, C. lycimnia, Encyrtus sp., and Hyperaspis signatus; compared to P. innumerabilis.

Bar-Zakay, I., Peleg, B.A. & Hefetz, A. 1989. Mating disruption of the California Red Scale, Aonidiella aurantii (Homoptera; Diaspididae). (Israel) Hassadeh 69(7): 1228-1231. (In Hebrew, English abstract)

Mating disruption as means of control for the California red scale was assessed and found successful, using a synthetic sex pheromone.

Batra, R.C., Sandhu, G.S. & Sohi, A.S. 1989. Outbreak of California Red Scale on citrus and suppression through Coccinellid predators in the Punjab. (India) Bulletin of Entomology 28(2):161-162.

Aonidiella aurantii found on Citrus grandis fruits; brief description of females and males; chemical control discussed; natural enemies.

Beattie, G.A. C., Weir, R.G., Clift, R.G. & Jiang, L. 1990. Effect of nutrients on the growth and phenology of Gascardia destructor (Newstead) and Ceroplastes sinensis Del Guercio (Hemiptera: Coccidae) infesting citrus. Journal of the Australian Entomological Society 29(Pt. 3):199-203.

The growth and phenology of the white wax scale and Chinese wax scale infesting Citrus sinensis were influenced by nitrogen content but not by other nutrients.

Bedford, E.C. G. 1990. 3.7 Mechanical Control: High-pressure Rinsing of Fruit. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 507-513; ill. (World Crop Pests.)

Spray unit described in detail; its use allows fewer pesticide applications to kill scale pests; exportation of unsightly fruit reduced; up to 80% of infested fruit has been saved by using this system.

Ben-Dov, Y. 1990. 3.9.10 Bamboo. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 655-660. (World Crop Pests.)

Table lists the hosts, distribution and references for the 58 diaspidid species reported on bamboo; 38 species of Diaspidini are known only from bamboo; 17 of 20 Odonaspidini are found only on bamboo; the 3 Aspidiotini species recorded from bamboo are very polyphagous.

Ben-Dov, Y. 1991. A new Rugaspidiotine genus and species (Hom., Coccoidea, Diaspididae) from the Oriental region. Entomologist's Monthly Magazine 127:49-51; ill.

Describes Rugpapuaspis proxantennata one of only two Rugaspidiotine species found on bamboo; from Papua New Guinea.

Ben-Dov, Y. 1990. On some described and a new species of Middle-Eastern mealybugs (Homoptera: Coccoidea: Pseudococcidae). Israel Journal of Entomology 24:5-15; ill.

New information given on taxonomy, host plants and distribution of 10 mealybug species from the Middle East.

Ben-Dov, Y. 1991. Parthenolecanium persicae (F.), a new pest of persimmon in Israel. (Israel) Hassadeh 72:347-348; ill. (In Hebrew, English abstract)

Family: Coccidae; recorded for first time in Israel; damages Diospyros kaki; biology.

Ben-Dov, Y. 1991. Scientific notes: first record of Ferrisia consobrina Williams & Watson (Homoptera: Coccoidea: Pseudococcidae) from Southern Africa. Journal of the Entomological Society of Southern Africa 54(1):85-86.

Reexamination of specimens labelled Ferrisia virgata showed some misidentifications; some were confused with F. consobrina, which is, therefore, recorded for the first time in South Africa (Transvaal) on Aptenia sp. and Arachis hypogaea, and Swaziland (Tambankulu) on Citrus paradisi.

Benassy, C. 1990. 3.9.6 Date Palm. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 585-591; ill. (World Crop Pests.)

Distribution, biology of Parlatoria blanchardi given; chemical control and use of natural enemies discussed.

Benassy, C. & Brun, P. 1989. Encarsia elongata Dozier (Hym.: Aphelinidae): a new entomophagous species introduced to France along with Citrus scale insects. (Encarsia elongata Dozier (Hym.: Aphelinidae) nouvel entomophage introduit en France au niveau de la faune des diaspines agrumicoles.) Med. Fac. Landbouww. Rijksuniv. Gent 54(3a):861-865. (In French, English abstract)

This species parasitizes Lepidosaphes gloverii.

Bennett, F.D. & Noyes, J.S. 1989. Three Chalcidoid parasites of Diaspines and whiteflies occurring in Florida and the Caribbean. Florida Entomologist 72(2): 370-373.

Caenohomolopoda shikokuensis described from Odonaspis penicillata; Arrhenophagus albitibiae parasitized Pseudaulacaspis pentagona; also on Aulacaspis rosae, Quadraspidiotus perniciosus and Q. forbesi; reared from P. pentagona and P. cockerelli.

Berry, J.A. 1990. Two parasitoid complexes: Hierodoris atychioides Butler (Lepidoptera: Oecophoridae) and Icerya purchasi Maskell (Homoptera: Margarodidae). New Zealand Entomologist 13:60-62.

I. purchasi was found to be the host of 2 primary parasitoids: Cryptochetum iceryae and Tetracnemoidea brevicornis, new record, and 2 hyperparasitoids: Trigonospila brevifacies and Xanthopimpla rhopaloceros, both new records.

Bhardwaj, S.P. 1988. Effect of summer application of insecticides on San Jose scale, Quadraspidiotus perniciosus, in orchards of apple (Malus pumila). Indian Journal of Agricultural Sciences 58(8):655-666.

13 chemical treatments evaluated and compared to a control group; contact insecticides proved superior to systemic insecticides in controlling this scale during summer.

Bhatti, S. 1991. Homoptera Coccoidea of New Caledonia. A revision of the Monophlebulini with a redefinition of the genus Tessarobelus Montrouzier (Margarodidae Monophlebinae). In J. Chazeau & S. Tillier (eds), Zoologia Néocaledonica, Volume 2. (Australia) Mem. Mus. natn. Hist. nat. (A) 149:131-149; ill. (In English, French abstract)

The monotypic genus Tessarobelus Montrouzier is redefined to include four new species: T. immaturus, T. inusitatus, T. ordinarius and T. perissoporosus as well as the type species T. querini. Key provided. A new genus Insulococcus is erected for a new species I. magnoporus. Adult females described.

Biassangama, A., Fabres, G. & Nenon, J.-P. 1988. The exotic parasite Epidinocarsis (Apoanagyrus) Lopezi (Hym. Encyrtidae) introduced into the Congo to control Phenacoccus manihoti in the laboratory and field (Hom. Pseudococcidae). (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 53-74. (In French)

Examines the duration of pre-imago development, longevity of adults, fecundity and rhythm of egg-laying, sexual rate, host-parasite relations, superparasitism, success of parasites, and the dispersion of parasites.

Biassangama, A., Le Ru, B., Iziquel, Y., Kiyindou, A. & Bimangou, A.S. 1988. The influence of the introduction of Epidinocarisis lopezi (De Santis) (Hym. Encyrtidae) on the evolution of the ecology surrounding the cassava mealybug Phenacoccus manihoti (Hom. Pseudococcidae) in the Congo. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 165-186. (In French, English abstract)

Review of fauna surrounding P. manihoti five years after introduction of Epidinocarsis lopezi into the Congo for control; 21 species of predators mentioned (Coleoptera, Lepidoptera, Diptera, Hemiptera, Neuroptera) and only one species of primary parasitoid (E. lopezi); the indigenous parasitoid Anagyrus sp. disappeared due to competition with E. lopezi.

Biassangama, A. & Moussa, J.B. 1988. The parasites of Epidinocarsis (Apoanagyrus) lopezi (Hymenoptera: Encyrtidae) in the Congo. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 99-102. (In French, French, English & Spanish abstract)

[Also published in l'Agronomie Tropicale (1987) 42-4.]

This encyrtid was released in the Congo in 1982 for control of Phenacoccus manihoti; 7 hyperparasites discussed.

Blank, R.H., Olson, M.H. & Lo, P.L. 1990. Armoured scale (Hemiptera: Diaspididae) aerial invasion into kiwifruit orchards from adjacent host plants. New Zealand Journal of Crop and Hort. Science 18(2-3):81-87.

Greedy scale, Hemiberlesia rapax invasion was monitored over five seasons from 1985 to 1990 in an orchard adjacent to Beilschmiedia taraire trees; intensity of invasion varied between generations and seasons; highest in kiwifruit (Actinidia deliciosa) blocks immediately adjacent to the taraire trees.

Blumberg, D. 1990. 2.6.4 Host Resistance: Encapsulation of Parasites. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 221-228; ill. (World Crop Pests.)

Explanation of encapsulation; discussion of the significance of this phenomenon with examples from various scale families; review of the few studies which have been done on encapsulation in the Diaspididae.

Blumberg, D. 1991. Seasonal variations in the encapsulation of eggs of the encyrtid parasitoid Metaphycus stanleyi by the pyriform scale, Protopulvinaria pyriformis. (Israel) Entomologia Experimentalis et Applicata 58:231-237.

Encapsulation rates correlate with ambient temperatures: lowest during cooler seasons and highest during hotter seasons; lower when avocado was host than when Hedera helix and Schefflera arboricola were hosts.

Blumberg, D. & Blumberg, O. 1991. The pyriform scale, Protopulvinaria pyriformis, and its common parasitoid, Metaphycus stanleyi, on avocado and Hedera helix. (Israel) Alon Hanotea 45(4):265-269. (In Hebrew, English abstract)

Phenology of this scale and its most common parasitoid studied on avocado and Hedera helix; encapsulation rates were low during winter and high during summer.

Blumberg, D. & Luck, R.F. 1990. Differences in the rates of superparasitism between two strains of Comperiella bifasciata (Howard) (Hymenoptera: Encyrtidae) parasitizing California Red Scale (Homoptera: Diaspididae): an adaptation to circumvent encapsulation? Annals of the Entomological Society of America 83(3): 591-597; ill.

This endoparasitoid has been introduced into California at various times for biological control of Aonidiella aurantii and A. citrina, not entirely successfully.

Boucek, Z. & Bhuiya, B.A. 1990. A new genus and species of Pteromalidae (Hym.) attacking mealybugs and soft scales (Hom., Coccoidea) on guava in Bangladesh. Entomologist's Monthly Magazine 126:231-235; ill.

Patiyana coccorum, new sp., is described; attacks coccoid insects on Psidium guajava in Bangladesh, including species of Phenacoccus, Planococcus, Rastrococcus and Chloropulvinaria.

Briales, M.J. & Campos, M. 1986. Study of the biology of Saissetia oleae (Olivier) (Hom. Coccidae) in Granada. (Estudio de la biologia de Saissetia oleae (Olivier) (Hom. Coccidae) en Granada).) (Spain) Boletin de la Asociacion de Entomologia (10):249-256. (In Spanish, English abstract)

One of the three worst pests on olives; polyphagous; probably of South American origin; distributed in the temperate zones of the northern hemisphere; found throughout Spain except the Costa Cantabrica; biology.

Brown, G.C. & Potter, D.A. 1990. 3.8.3 The Systems Approach to Integrated Pest Management with Emphasis on the Armored Scale Insects. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 527-533. (World Crop Pests.)

Traditional concepts of systems approach are defined; use of systems approach in IPM in orchards is reviewed; discussion of its use in scale insect management in urban areas; suggestions for future directions of system analysis in scale insect research and pest management.

Bruwer, I.J. & Schoeman, A.S. 1990. Key factor analysis of two populations of the long mussel scale, Insulaspis gloverii (Packard) (Hemiptera: Diaspididae). Journal of the Entomological Society of Southern Africa 53(1):101-105.

The four factors influencing the total generation mortality of two populations of the long mussel scale in citrus orchards were predation (mainly by Chilocorus nigritus), ectoparasitism (by Aphytis lepidosaphes), endoparasitism (by Aspidiotiphasus citrinus), and an unknown mortality factor.

Buckley, R.C. & Gullan, P.J. 1991. More aggressive ant species (Hymenoptera: Formicidae) provide better protection for soft scales and mealybugs (Homoptera: Coccidae, Pseudococcidae). (Australia) Biotropica 23(3):282-286.

For 11 sets of interacting species in Papua New Guinea, coccoids attended by relatively inoffensive ants were more heavily parasitized than those attended by more aggressive ants.

Burger, H.C. & Ulenberg, S.A. 1990. 3.2 Quarantine Problems and Procedures. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p.313-327; ill. (World Crop Pests.)

History of trade in transporting plants and methods to control introduction of pests with them; discussion of quarantine regulations; list of species often under quarantine; discussion of importance of identification and documentation; section on risk analysis including chances of pest becoming established and extent of damage that may result; discussion of export and import requirements; recommendations for a better policy on world trade in plants.

Burts, E.C., Beers, E.H. & Hill, W.B. 1990. Grape mealybug (Homoptera: Pseudococcidae) on pear and apple in North-Central Washington. Bull. SROP (Sect. Reg. Ouest Palearctique) 13(2):170-172.

Pseudococcus maritimis has become a serious pest of pear and apple; natural enemies include Acerophagus notativentris; biology; chemical control.

Burts, E. 1991. Pear: Pyrus communis L. "d'Anjou"; Pear psylla (PP); Psylla pyricola Foerster; Grape mealybug (GMB): Pseudococcus maritimus (Ehrhorn). In Insecticide and Acaricide Tests. Thomas, J. H. (Ed.) Lanham, Maryland: Entomological Society of America. Vol. 16; p. 22-23.

Chemical control described.

CAB International Institute of Entomology. 1987. Maconellicoccus hirsutus (Green). Distribution Maps of Pests Map no. 100 (rev.):2 pp.; ill. (Series A, Agricultural.)

Map showing distribution of this sp. worldwide; countries listed with references to records; synonymy; common names; host plants include Hibiscus spp., Boehmeria, mulberry, jute and grapevine.

CAB International Institute of Entomology. 1986. Quadraspidiotus perniciosus (Comstock). Distribution Maps of Pests Map no. 7 (rev.):3 pp.; ill. (Series A, Agricultural.)

Map showing distribution of this sp. worldwide; countries listed with references to records; also called San Jose scale, California scale; polyphagous; host plants include most deciduous fruits (trees and shrubs).

CAB International Institute of Entomology. 1988. Unaspis yanonensis (Kuwana) (Hemiptera: Coccoidea, Diaspididae). Distribution Maps of Pests Map no. 503 (rev.):2 pp.; ill. (Series A, Agricultural.)

Commonly called oriental citrus scale or arrowhead scale; map showing distribution of this sp. worldwide; countries listed with references to records; host plants include Citrus.

Campbell, C.A. M. 1990. The susceptibility of cocoa to mealybugs (Pseudococcidae) and other honeydew-producing Homoptera in Ghana. Bulletin of Entomological Research 80(2):137-151.

68 cocoa progenies examined by inspection and dissection of terminal buds; Planococcoides njalensis was most common.

Chandra, A., Bhati, D.P. S. & Singh, K.M. 1987. Bionomics of mango mealy bug, Drosicha mangiferae Green (Margarodidae: Hemiptera). (India) Bulletin of Entomology 28(2):145-152; ill.

Potential threat to mango in western parts of Uttar Pradesh; sap sucked from tender parts of trees to cause drying and fruit drop; black sooty mould develops due to honeydew secretion and interferes in photosynthesis.

Chandra, A., Singh, K.M. & Bhati, D.P. S. 1989. Egg laying behaviour of gravid females of mango mealy bug, Drosicha mangiferae Green as influenced by soil moisture regimes. (India) Indian Journal of Entomology 51(1):101-104; ill.

Important polyphagous pest attacking various fruits, vegetables, flowers and trees; nymphs of both male and female and adult female crawl up to trees and suck vital sap from tender parts including leaves, twigs and inflorescence, resulting in poor fruit setting and lower yield.

Chandra, H.S. & Nanjundiah, V. 1990. The evolution of genomic imprinting. In Development Supplement: Genomic Imprinting, edited by M. and Surani, A., Eds. Monk. Manchester, England: April 1990. Cambridge, England: The Company of Biologists Ltd.; 47-54; ill.

Three possible pathways for the evolution of genomic imprinting explored: 1. Imprinting may be advantageous in itself when imprinted and unimprinted alleles of a locus confer different phenotypes. 2. Genes responsible for imprinting may have pleiotropic effects and they may have been selected for reasons other than their imprinting ability. 3. Imprinting could have co-evolved with other traits.

Chandra, J. 1988. Natural enemies of sugarcane scale insect and methods of their multiplication -- a review. (India) Agricultural Reviews 9(3):163-169.

A list of natural enemies of Melanaspis glomerata reported in India; about 12 parasites and six predators; methods used to rear them in the laboratory reviewed.

Chandra, J. & Avasthy, P.N. 1986. Biology of Sticholotis madagassa Weise on Melanaspis glomerata (Green) infesting Erianthus munja. (India) Bulletin of Entomology 27(2):p. 194-196.

Predatory beetle of sugarcane armored scale in Mauritius, East Africa and Reunion; imported into India; for control of M. glomerata;

Chen, X., Hu, S., Li, Z., Che, X., Li, F. & Wan, W. 1987. A preliminary survey of the scale insects, aphids and mites occurring on ornamental plants in Beijing district. (China) Journal of Beijing Forestry University 9(2):202-212. (In Chinese, English abstract)

32 species representing six families of scales are listed; distributions; hosts; damage.

Chua, T.H. & Wood, B.J. 1990. 3.9.2 Other Tropical Fruit Trees and Shrubs. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 543-552. (World Crop Pests.)

Although many diaspidids attack tropical fruit trees and shrubs, few are serious pests, probably because of good control by natural enemies; the pests known to attack the following plants are listed and some notes are given about their pest status and control: coconut, oil palm, rubber, mango, papaya, pinneapple, banana, guava, durian, rambutan, tea, cocoa, coffee, avocado, fig, walnut, pecan, almond, cassava, yam, tumeric, ginger, grape & apple.

Claps, L.E. 1991. Morphology of Cornuaspis beckii (Newman) and Insulaspis gloverii (Packard) immatures and adults (Homoptera; Coccoidea; Diaspididae). (Morfologia de estados inmaduros y adultos de Cornuaspis beckii (Newman, 1869) e Insulaspis gloverii (Packard, 1869) (Homoptera; Coccoidea; Diaspididae).) (Argentina) Revta Soc. ent. argent. 49(1-4):137-149; ill. (In Spanish, English abstract)

Descriptions and comparisons of eggs, nymphs, second stage instars, adult males and females, pupas and prepupas of both species; hosts.

Clarke, S.R., DeBarr, G.L. & Berisford, C.W. 1990. Effects of fenvalerate and azinphosmethyl on scale insects and their natural enemies in loblolly pine seed orchards. Southeastern Forest Experiment Station (Asheville, NC) (Report No. FSRP- SE-279):14 pp.

Orchard infested with Toumeyella pini, Oracella acuta and Pseudophilippia quaintancii; results indicate that ground applications of these chemicals are effective while aerial application is not.

Cockfield, S.D. & Potter, D.A. 1990. Euonymus scale patterns of damage to woody plants. Journal of Arboriculture 16(9):239-241. (In English, French abstract)

Feeds on both leaves and stems; produces chlorotic halo that is deficient in chloroplasts; infested leaves have impaired photosynthesis and are prone to abscission; healthy plants may outgrow injury, but those that have additional stresses may not; early detection and management can help.

Cockfield, S.D. & Potter, D.A. 1986. Interaction of Euonymus scale (Homoptera: Diaspididae) feeding damage and severe water stress on leaf abscission and growth of Euonymus fortunei. Oecologia 71(1):41-46.

Experiment showed significant interaction between Unaspis euonymi infestation and water stress, with a synergistic effect on leaf abscission. Both scale infestation and water stress reduced the root weight, but there was no resulting change in the root/shoot ratio.

Cockfield, S.D. & Potter, D.A. 1990. Euonymus scale (Homoptera: Diaspididae) effects on plant growth and leaf abscission and implications for differential site selection by male and female scales. Journal of Economic Entomology 83(3):995-1001.

Characteristic distribution of Unaspis euonymi with males mainly on leaves and longer-lived females on stems, reflects the relatively greater risk to females of mortality from leaf abscission and from winter injury to leaves (of Euonymus fortunei).

Crause, C. 1990. The white peach scale, Pseudaulacaspis pentagona (Targioni-Tozzetti) (Homoptera: Diaspididae), a pest of economic importance on granadilla. In Tropical and Subtropical Fruits. July 1991. (Acta Horticulturae, No. 275.) 655-662.

This species is a pest on Passiflora edulis, which is often grafted onto rootstock of Passiflora caerulea; damage described; can be bred on Cucurbita moschata and Solanum tuberosum; parasitoids include Aspidiotiphagus sp. and Arrhenophagus chionaspidis; pest on Morus rubra in Japan, and previously on Prunus persica in Georgia.

Crosby, T.K. 1991. Obituary: Clare Frances Morales, B.Sc., M.Sc. (Hons), Ph.D., D.I.C. 1946-1991. New Zealand Journal of Zoology 18:459-462; ill.

Profile of Clare F. Butcher Morales, entomologist; list of her published works, works in progress and theses.

Daane, K.M. & Caltagirone, L.E. 1989. Biological control of black scale in olives. California Agriculture 43(1):9-11; ill.

Cultural practices that improve biological control of Saissetia oleae in olive orchards are more common in northern than southern California orchards; a parasite has recently been imported from Spain and established for biological control; in Tulare county, open trees, low-volume sprinklers and no ground cover caused fluctuations in pest populations, and did not favor establishment of parasitoids; in Tehama county, olive trees were pruned high above the ground with their branches touching, combined with ground cover and high volume sprinkler systems, which was favorable for pest and its parasitoids.

Darvas, B. & Varjas, L. 1990. 3.5.2 Insect Growth Regulators. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 393-408. (World Crop Pests.)

Discussion of two main groups of regulators -- cuticle formation inhibitors and those influencing development hormones; structure of chemicals with trade and common names; examples of effects on insects and their natural enemies given; table lists species of Diaspididae and summarizing effects of insect growth regulators on those species.

Das, S.C. 1988. Studies on Aphytis sp. ? chrysomphali (Mercet) -- a parasite of black scale, Chrysomphalus aonidium (=C. ficus) Ashm. Two and a Bud 35(1-2):44-45.

Discusses mating and oviposition, egg, larva, pupa and adult of this parasite.

Davidson, J.A. & Miller, D.R. 1990. 3.9.8 Ornamental Plants. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 603-632. (World Crop Pests.)

Over 20,000 species of ornamental plants in N. America; diaspidids seem well adapted to living on plants in urban landscapes; control difficult because of proximity to humans; oils, systemic insecticides, & integrated pest management are discussed; various factors contributing to damage are covered; representative pest species occurring in 7 different ornamental situations are discussed; table of 49 species has information on external appearance, host range, major hosts, feeding sites, generations per year & distribution.

De Lotto, G. 1990. Comments on the proposed designation of Lecanium coffeae Walker, 1852 as the type species of Saissetia Deplanche, 1859 (Insecta, Homoptera) (Case 2677) (1). Bulletin of Zoological Nomenclature 47(1):47-48.

This author supports the designation of Lecanium coffeae Walker as the type species of Saissetia as proposed by Y. Ben-Dov.

Donaldson, J.S. & Walter, G.H. 1991. Brood sex ratios of the solitary parasitoid wasp, Coccophagus atratus. Ecological Entomology 16(1):25-33.

Female eggs of this parasite are deposited with the haemolymph of coccoid scale insects; Filippia gemina used for observations.

Donaldson, J.S. & Walter, G.H. 1991. Host population structure affects field sex ratios of the heteronomous hyperparasitoid, Coccophagus atratus. Ecological Entomology 16(1):35-44.

Second instar Filippia gemina scale insects are the preferred hosts of female of this parasitoid.

Duso, C. 1989. Indigenous bioecology of Planococcus ficus (Sign.) in the Veneto region. (Indagini bioecologiche su Planococcus ficus (Sign.) nel Veneto.) (Italy) Bollettino del Laboratorio di Entomologia Agraria "Filippo Silvestri" 46:3-20; ill. (In Italian, Italian & English abstract)

P. ficus overwinters as adult female and develops 3 generations per year, starting towards the end of May; sampling methods discussed; natural enemies.

Dutta, S.K. & Devaiah, M.C. 1990. Infestation of sugarcane scale, Melanaspis glomerata Green on some popular and promising sugarcane varieties in Karnataka. Indian Sugar 40(3):161-163.

One variety of sugarcane, out of 8 tested, was found to be relatively resistant to M. glomerata infestation; nymphs and adult females suck the stem sap and thereby reduce cane yield, and quality and quantity of juice.

Dziedzicka, A. 1989. Scale insects (Coccinea) occurring in Polish greenhouses I. Diaspididae. Acta Biologica Cracoviensia; Series: Zoologia 31:93-114; ill.

Brief characteristics of 18 scale species; hosts; damage; distribution.

Einhorn, J., Menassieu, P., Malosse, C. & Ducrot, P.-H. 1990. Identification of the sex pheromone of the maritime pine scale Matsucoccus feytaudi. (France) Tetrahedron Letters 31(46):6633-6636.

Endemic pest of the maritime pine, Pinus pinaster in Europe and Africa; investigation of sex pheromone produced by this species may help in survey and control strategies.

Eisa, A.A., El-Fatah, M.A. & El-Dash, A.A. 1991. Inhibitory effects of some insect growth regulators on developmental stages, fecundity and fertility of the Florida wax scale, Ceroplastes floridensis. (Egypt) Phytoparasitica 19(1):49-55.

When first nymphal stages were treated, fewer adults were found on treated guava plants at the end of the first generation compared to untreated plants. The JHAs fenoxycarb and R-20458 arrested development and no adults emerged at end of first generation. With 50 ppm of the JHAs Pro-drone only 5.2% of the nymphs developed into adults. Triflumuron and dofenapyn were superior to the other insect MICs in hampering development. Adults emerging at the end of the first generation were parental scales for the next generation. Delayed adverse effects were observed on female fecundity and egg hatchability. Significant difference between number of eggs laid by females in the treatments and the control, and also between the different IGRs. No eggs hatched with dofenapyn; egg hatchability was 46% for teflubenzuron vs 88% for the control.

El-Kareim, A.I. Abd, Darvas, B. & Kozar, F. 1989. Effects of juvenoids on prediapause and postdiapause females of Epidiaspis leperii Sign. (Hom., Diaspididae). Acta Phytopathologica et Entomologia Hungarica 24(3-4):473-482.

Treating prediapause females of this species with juvenoids kinoprene, methoprene, hydroprene, and fenoxycarb did not affect the hormonal regulation of adult diapause. This may be due to a high activity of JH-esterase in the prediapause phase. Only when prediapause and postdiapause females were treated with juvenoids at a high concentration (0.5%) was vitellogenesis reduced. Egg hatch was inhibited when the juvenoids methoprene and kinoprene, at a concentration of 0.1%, were applied to postdiapause females of E. leperii.

Emehute, J.K. U. & Egwuatu, R.I. 1990. Prospects for integrated control of the cassava mealybug Phenacoccus manihoti Mat.-Ferr. in Nigeria. In Integrated Pest Management for Tropical Root and Tuber Crops, edited by S. K. Hahn and F. E. Caveness. Ibadan, Nigeria: 25 - 30 October 1987. Ibadan, Nigeria: International Institute of Tropical Agriculture; pp. 180-184.

Components of integrated control discussed such as cultural practices (early planting, mulching, good phytosanitary practices and burying stakes completely in the soil), development and use of tolerant cultivars, pesticides, and biological control.

Fabres, G. 1988. The influence of the "capacity limit" for regulating abundance of a phytophage: an example of the cassava mealybug in the Congo. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 43-52. (In French)

Examines Phenacoccus manihoti and its colonies for such phenomena as changes in structure related to the age of colonies.

Fabres, G., Nenon, J.-P., Kiyindou, A. & Biassangama, A. 1988. Discussion of exotic entomophages introduced into the Congo to control the cassava mealybug. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 103-110. (In French)

Examines the rate of parasitism of Phenacoccus manihoti and the potential increase of Coccinellidae predators.

Fenton, F.A. 1940. The brown elm scale: description and control. Experiment Station Bulletin, Oklahoma (245):6 pp.

Lecanium corni common on elms in Oklahoma; hosts; damage; brief description; life cycle; chemical control.

Fernandez-Garcia, E., Evans, H.C. & Samson, R.A. 1990. Hirsutella cryptosclerotium sp. nov., an entomopathogen of the mealybug pest, Rastrococcus invadens, in West Africa. (Great Britain) Mycological Research 94(8):1111-1117; ill.

This fungus collected in Togo; description; not known if it is restricted to Rastrococcus.

Fiala, B. 1990. Extrafloral nectaries vs ant-Homoptera mutualisms: a comment on Becerra and Venable. (Germany) Oikos 59(2):281-282.

Previous hypothesis suggests that function of extrafloral nectaries (EFNs) may not exclusively be to attract ants which defend plants against herbivores; factors opposing this view are discussed; obligate myrmecophytes in the Macaranga genus do not secrete sugar-containing fluids and colonizing ants keep scale insects inside the hollow stems of their host plants; a reduction of nectary production appears to be favored.

Foldi, I. 1990. Morphology of the larval and imago stages of the male Eurhizococcus brasiliensis (Hempel in wille, 1922) (Homoptera: Coccoidea: Margarodidae). (Morphologie des stades larvaires et imaginal du male d'Eurhizococcus brasiliensis (Hempel in wille, 1922) (Homoptera: Coccoidea: Margarodidae).) Nouvelle Revue d'Entomologie 7(4):405-418; ill. (In French, English abstract)

Known as exclusively parthenogenetic; 5 stages described and illustrated: L1 (mobile, then fixed), L2 (cyst), propupa, pupa and adult male; etiology.

Foldi, I. 1991. The wax glands in scale insects: comparative ultrastructure, secretion, function and evolution (Homoptera: Coccoidea). Annls. Soc. ent. Fr. (N.S.) 27(2):163-188; ill. (In English, French abstract)

The diversity of those cuticular structures transporting and discharging secretions were described, and their evolution and value in systematics were discussed. In addition, the shaping mechanism of the secretion, their micromorphology, chemical composition, functional significance, were analyzed.

Foldi, I. & Soria, S.J. 1989. Scale insects injurious to vineyards in South America (Homptera: Coccoidea). (Les cochenilles nuisibles a la vigne en amerique du sud (Homoptera: Coccoidea).) Annales de la Societe entomologique de France (N.S) 25(4):411-430; ill. (In French, English abstract)

13 species discussed: Eurhizococcus brasiliensis, Margarodes vitis, Icerya schrottkyi, Duplaspidiotus fosser, Parthenolecanium corni, P. persicae, Duplaspidiotus tesseratus, Pseudococcus maritimus, P. affinis, Planococcus ficus, Cryptokermes brasiliensis, Aspidiotus nerii & Pseudococcus longispinus; 23 others listed; biology; economic importance; control.

Fontenla Rizo, J.L., Rodriguez, R. & Suri, M. 1987. Structure and organization of two communities of Coccoidea (Insecta: Homoptera) in two citrus cultivars. (Estructura y organizacion de dos comunidades de Coccoidea (Insecta: Homoptera) en dos cultivares de citricos).) Reporte de Investigacion del Instituto de Ecologia y Sistematica (Academia de Ciencias de Cuba, Havana) (45):28 pp. (In Spanish, English abstract)

The most common species found in the untreated field were: Selenaspidus articulatus, Unaspis citri, Coccus viridis, C. hesperidum, Lepidosaphes beckii, L. gloverii and Chrysomphalus dictyospermi; the communities show a well-defined organization; resource sharing was evident, with species using different parts of the plants in different ways; ecological segregation and not competition determined the organization of the communities in the agroecosystems.

Furuhashi, K. & Ookubo, N. 1990. Use of parasitic wasps for controlling the arrowhead scale, Unaspis yanonensis (Homoptera, Diaspididae), in Japan. In FFT-NARC International Seminar: the Use of Parasitoids and Predators to Control Agricultural Pests. Tukuha Science City, Ibaraki-ken, Japan: October 2-7, 1989. Tukuba-gun, Japan: National Agricultural Research Centre (NARC); 19 pp. (In English, Japanese abstract)

History of biological control attempts in Japan; found on citrus; ecology; Aphytis yanonensis and Coccobius fulvus most successful natural enemies.

Gaffar, S.A. 1989. Chemical control of mealy bug, Drosicha dalbergiae (Stebbing) on almond in Kashmir. Indian Journal of Plant Protection 17(1):31-34.

This species also found on apple, walnut and other stone and nut fruit trees; damage described; 6 treatments evaluated and compared to control; Quinalphos (0.10%) as soil drench around collar region of the trees (at 3 l/ tree) was found the most effective, giving about 80-85% control.

Gahan, A.B. 1907. The peach lecanium or terrapin scale. Bulletin (Maryland Agricultural Experiment Station) (123):153-160; ill.

Eulecanium nigro-fasciatum; previously confused with Eulecanium persicae; found on peach, maple, plum, apple, linden, birch, sycamore, poplar and blueberry; description of damage; parasites; chemical control.

Garonna, A.P. & Viggiani, G. 1989. Preliminary information on Comperiella lemniscata Compere & Annecke (Hymenoptera: Encyrtidae) parasitoid of Chrysomphalus dictyospermi (Morg.) in Italy. (Notizie preliminari sulla Comperiella lemniscata Compere & Annecke (Hymenoptera: Encyrtidae), parassitoide di Chrysomphalus dictyospermi (Morg.) in Italia.) Redia 72(2):523-527; ill. (In Italian, English abstract)

Comperiella lemniscata recorded for first time in Italy; distribution; activity of encrytid; previously found only in India, Pakistan and China.

Gerson, U., O'Connor, B.M. & Houck, M.A. 1990. 2.2.6 Acari. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 77-97; ill. (World Crop Pests.)

Review of 10 families of Acari which are predators or parasites of Diaspididae and their mite hosts; taxonomy; bionomics; worldwide distribution.

Ghosh, A.B. & Ghose, S.K. 1989. Descriptions of all instars of the mealybug Nipaecoccus viridis (Newstead) (Homoptera, Pseudococcidae). (India) Environment & Ecology 7(3):564-570; ill.

Descriptions, illustrations and a key to all instars of this species, including males; distributed in the Oriental, Palearctic and Ethiopian Regions; major pest of Citrus, Gossypium and Artocarpus integra.

Gieselmann, M.J. & Rice, R.E. 1990. 3.4.3 Use of Pheromone Traps. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 349-352. (World Crop Pests.)

Ways in which pheromone traps can be used for control of scale insects are listed; discussion of conditions affecting stability of pheromones, trap design and placement, integration with chemical control, use in conjunction with natural parasites and predators, use in determining phenology of pest and applying data in modeling, cost of pheromone development and monitoring.

Gill, R.J. 1990. 3.3 Eradication. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 329-333. (World Crop Pests.)

Definition of eradication; history of insect control programs in general and scale control programs in particular; techniques of eradication.

Giordanengo, P. & Nenon, J.-P. 1990. A study of the life cycle of Epidinocarsis (=Apoanagyrus) lopezi equals Apoanagyrus-Lopezi (Hymenoptera: Encyrtidae) introduced parasitoid on the Cassava mealybug Phenacoccus manihoti (Homoptera: Pseudococcidae) in Africa. Journal of African Zoology 104(6):549-556; ill. (In English, French abstract)

Stages observed or measured include egg segmentation, embryogenesis, hatching, larval instars, pre-nymphal and nymphal instars.

Godfray, H.C. J. & Waage, J.K. 1991. Predictive modelling in biological control: the mango mealy bug (Rastrococcus invadens) and its parasitoids. (Great Britain) Journal of Applied Ecology 28:434-453.

Age-structured host/parasitoid population models with overlapping generations used to investigate their interactions; models predict that Gyranusoidea tebygi will lead to a greater decrease in host density than Anagyrus sp.

Goergen, G. & Neuenschwander, P. 1990. Biology of Prochiloneurus insolitus (Alam) (Hymenoptera, Encyrtidae), a hyperparasite on mealybugs (Homoptera, Pseudococcidae): immature morphology, host acceptance and host range in West Africa. (Germany) Mitteilungen der Schweizerischen Entomol. Gesellschaft 63(3-4):317-326; ill.

P. insolitus offered various stages of Epidinocarsis lopezi, a primary parasitoid of the cassava mealybug, Phenacoccus manihoti; morphology and life cycle; host selection; host range; hyperparasitism did not seem to prevent effective biological control.

Gokkes, M., Eshel, G. & Tadmor, U. 1989. Field trials for the control of Chaff Scale and Florida Wax Scale in citrus orchards with tiger (Pyriproxifen). (Israel) Hassadeh 69(11):2019. (In Hebrew, English abstract)

Concentrations of 0.05%-0.1% Tiger were at least as effective in controlling Parlatoria oleae and Icerya purchasi as summer oil,Supracide or Folimet tank-mixed with carbosulfan; summer oil was least effective.

Gonzalez, R.H. & Lamborot, L. 1989. The genus Saissetia Deplanche in Chile (Homoptera: Coccidae). (El genero Saissetia Deplanche en Chile (Homoptera: Coccidae).) Acta Entomologica Chilena 15:237-242; ill. (In Spanish, English abstract)

A survey of black scales belonging to this genus was conducted in parts of Chile; only two species identified: S. coffeae and S. oleae; host plants; descriptions; distribution; biology; natural enemies.

Goux, L. 1990. A study of the qualitative bonds during emergence of living beings using mealybugs as an example. (Contribution a l'etude de la genese des bonds qualitatifs ou emergences chez les etres vivants d'apres l'exemple des cochenilles.) Bulletin de la Societe Linnea de Provence 41:151-159; ill. (In French, English, Esperanto abstract)

Discussion of the theoretical problem; reasons for studying wax in mealybugs; genera of Coccoidea mentioned include Eriococcus, Heliococcus, Peliococcus, Chlamydolecanium, Eriopeltis, Ceroplastes, Rhizoecus, Pararhizoecus, Atrococcus, Cerococcus, Asterolecanium, Luzulaspis and Rhizaspidiotus.

Grout, T.G. & Richards, G.I. 1989. The multiple cohort structure in populations of red scale, Aonidiella aurantii (Maskell) (Homoptera: Diaspididae), on citrus in South Africa. Journal of the Entomological Society of Southern Africa 52(2):277-283.

Dual cohort structure appears to be the result of cyclic peaks in crawler emergence; dual cohort structures existed where red scale male flight peaks exceeded 1,000 males per card pheromone trap per week and parasitoids exerted little effect; a triple cohort structure occurred when red scale male flight peaks did not exceed 800 males per card pheromone trap per week, which was usually in the presence of Aphytis parasitoid species.

Grout, T.G. & Richards, G.I. 1991. Value of pheromone traps for predicting infestations of red scale, Aonidiella aurantii (Maskell) (Hom., Diaspididae), limited by natural enemy activity and insecticides used to control citrus thrips, Scirtothrips aurantii Faure (Thys., Thripidae). (South Africa) Journal of Applied Entomology 111:20-27. (In English, German abstract)

Aonidiella aurantii males and several of its Aphytis parasitoid species were monitored using sticky yellow card traps in Citrus sinensis orchards; in Israel, citrus thrips does not occur, chemical treatments are not used as much, and red scale parasitoids would probably be more stable and allow some degree of prediction; traps can be used best in South Africa for indicating presence of red scale in the tops of trees, early indication of relative population densities in different orchards, timing releases of A. melinus, timing insecticide applications, and controlling red scale by mating disruption.

Guerrieri, E. 1989. Description of the male of Asitus phragmitis (Ferriere) (Hymenoptera: Encyrtidae), parasitoid of Chaetococcus phragmitis (Mar.) (Homoptera: Pseudococcidae). (Descrizione del maschio di Asitus phragmitis (Ferriere) (Hymenoptera: Encyrtidae), parassitoide di Chaetococcus phragmitis (Mar.) (Homoptera: Pseudococcidae).) (Italy) Bollettino del Laboratorio di Entomologia Agraria "Filippo Silvestri" 46:157-162; ill. (In Italian, Italian & English abstract)

C. phragmitis develops on leaf sheathes of Arundo species, especially A. phragmites.

Gullan, P.J. 1989. Origin and phylogeny of scale insects (Coccoidea). (Australia) News Bulletin (Entomological Society of Queensland) 17(5):51-56.

Coccoidea contains more than 6000 described species worldwide; found within 19-23 families; 14 families and about 10% of the species recorded from Australia.

Gullan, P.J. & Vranjic, J.A. 1991. The taxonomy of the gum tree scales Eriococcus confusus Maskell and E. coriaceus Maskell (Hemiptera: Coccoidea: Eriococcidae). (Australia) Gen. Appl. Ent. 23:21-40; ill.

Common pests of urban plantings of Eucalyptus in southeastern Australia; these two species can be difficult to distinguish due to variability of adult females; redescriptions; key to adult females of 12 species of Australian Eriococcus.

Gullan, P.J. 1991. (Book Reviews) Margarodidae (Insecta: Hemiptera). Fauna of New Zealand Number 21. New Zealand Journal of Zoology 18:451-453.

Reviews this volume by Clare Morales; mentions the inclusion of information on both adult females and immature stages; errors mentioned with citation of type data.

Haley, S., Currans, K.G. & Croft, B.A. 1990. A computer aid for decision-making in apple pest management. In 2nd International Symposium on Computer Modelling in Fruit Research and Orchard Management. Logan, Utah: 5-8 September 1989. (Acta Horticulturae, No. 276.) 27-33.

The decisions discussed involve codling moth, phytophagous mites, and San Jose scale (Quadraspidiotus perniciosus Comstock); the system identifies pests from the injury they cause on buds, fruit, leaves or bark; determines names of pests and their common natural enemies; calculates net benefit of a pesticide application; predicts damage; compares side effects of alternative pesticides.

Hammond, W.N. O. & Neuenschwander, P. 1990. Sustained biological control of the cassava mealybug Phenacoccus manihoti (Hom.: Pseudococcidae) by Epidinocarsis lopezi (Hym.: Encyrtidae) in Nigeria. Entomophaga 35(4):515-526. (In English, French abstract)

Two years after introduction of E. lopezi, populations of P. manihoti remained mostly below 10 per tip; indigenous polyphagous coccinellids were found only during peak host densities, whereas the species E. lopezi was common throughout the year.

Hanks, L.M. & Sadof, C.S. 1990. The effect of ants on nymphal survivorship of Coccus viridis (Homoptera: Coccidae). (Venezuela) Biotropica 22(2):210-213. (In English, Spanish abstract)

Some scale insects provide nutrition in the form of honeydew for ants; prevention of accumulation of honeydew by ants can discourage growth of fungi harmful to the scale; this study investigates the possibility that removal of Crematogaster and Camponotus attending Coccus viridis might deprive them of essential protection.

Hare, J.D., Yu, D.S. & Luck, R.F. 1990. Variation in life history parameters of California red scale on different citrus cultivars. Ecology 71(4):1451-1460.

Measurement of survival, growth rate, and initial egg complement when reared on foliage and bark of four citrus cultivars; Citrus limon and C. paradisi were most suitable for scale survival and growth; C. unshiu was almost unsuitable; C. sinensis was intermediate.

Hart, W.G. 1990. 3.4.4 Remote Sensing. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 353-356; ill. (World Crop Pests.)

Techniques of remote sensing are based on detection of damage caused by pest and not detection of insect itself; however, damage caused by Diaspididae is usually not detectable, so instead of damage, factors that influence population increase can be used such as, planting patterns that indicate potential pesticide drift, dusty areas near crops, varietal differences, distribution and density of susceptible hosts, presence of abandoned groves.

Hashimoto, A. & Ichimoto, I. 1990. (S)-3-Acetyl-1,2-Diacyl-sn-Glycerols from the lipids of Drosicha corpulenta Kuwana (Homoptera: Margarodidae). (Japan) Appl. Ent. Zool 25(4):515-516.

Monoacetyldiacylglycerols (MADGs) isolated and characterized from this species.

Hattingh, V. & Samways, M.J. 1990. Absence of intraspecific interference during feeding by the predatory ladybirds Chilocorus spp. (Coleoptera: Coccinellidae). Ecological Entomology 15(4):385-390.

Feeding rate did not decrease and dispersal did not increase with increasing predator density; results help to explain the relative importance of parasitoids and predators in the effective control of Aonidiella aurantii.

Hattingh, V. & Samways, M.J. 1991. Determination of the most effective method for field establishment of biocontrol agents of the genus Chilocorus (Coleoptera: Coccinellidae). (South Africa) Bulletin of Entomological Research 81:169-174.

Chilocorus nigritus is an economically important biocontrol agent of red scale, Aonidiella aurantii on citrus in southern Africa; C. bipustulatus controls A. aurantii on citrus in Israel. Other species mentioned in relation to Chilocorus are Parlatoria oleae, Aspidiotus nerii and Asterolecanium species.

Hernandez, M. & Ceballos, M. 1987. New hosts for bioregulators of coccids on citrus. (Nuevos hospedantes para biorreguladores de coccidos en citricos.) (Cuba) Revista de proteccion vegetal 2(2):178-182. (In Spanish, English abstract)

Samples in 8 citrus groves revealed 8 new scale hosts for Aphelinidae and Encyrtidae.

Hibbard, B.E., Lanier, G.N., Parks, S.C., Qi, Y.T., Webster, F.X. & Silverstein, R.M. 1991. Laboratory and field tests with the synthetic sex pheromone of three Matsucoccus pine bast scales. Journal of Chemical Ecology 17(1):89-102.

Matsucoccus resinosae, M. thunbergianae and M. matsumurae examined; Synthetic matsuone was tested in the laboratory and in the field; significantly more males responded than to controls; may be a valuable component in the management programs of these species.

Hodgson, C.J. 1991. A redescription of Pseudopulvinaria sikkimensis Atkinson (Homoptera, Coccoidea) with a discussion of its affinities. (Great Britain) Journal of Natural History 25:1513-1529; ill.

Adult female and crawler of this species redescribed; 2nd and 3rd instar female, the 2nd instar male, pupa and adult male are described for first time; this species previously considered to belong in family Eriococcidae, but present study places it in family Coccidae; synonymy of Lefroyia castanea Green confirmed; lectotype designated.

Hodgson, C.J. & Hilburn, D.J. 1991. An annotated checklist of the Coccoidea of Bermuda. Florida Entomologist 74(1):133-146. (In English, Spanish abstract)

85 species recorded (including 5 doubtful records); two species killed nearly all the mature indigenous cedar in the late 1940s and 1950s (Carulaspis minima and Insulaspis pallida); number of plant familes and genera on which each recorded; current status in Bermuda; brief histories; biological control; museums where specimens can be found.

Hodgson, C.J. & Hilburn, D.J. 1990, reprinted 1991. List of plant hosts of Coccoidea recorded in Bermuda up to 1989. Hamilton, Bermuda: Department of Agriculture, Fisheries & Parks, Botanical Gardens, Paget, Bermuda. 22 pp. (Bulletin No. 39.)

Alphabetical listing of all (over 800) plant genera on which Coccoidea have been recorded from Bermuda, with plant families and scale species for each.

Hodgson, C. 1990. Comments on the proposed designation of Lecanium coffeae Walker, 1852 as the type species of Saissetia Deplanche, 1859 (Insecta, Homoptera) (Case 2677) (2). Bulletin of Zoological Nomenclature 47(1):48.

This author supports the designation of Lecanium coffeae Walker as the type species of Saissetia as proposed by Y. Ben-Dov.

Hodgson, C.J. 1991. A revision of the scale insect genera Etiennea and Platysaissetia (Homoptera: Coccidae) with particular reference to Africa. Systematic Entomology 16(2):173-221; ill.

From a study of P. castilloae, the type species of Platysaissetia Cockerell, it is considered that none of the other species presently placed in Platysaissetia are congeneric. All known species from Africa (and one from British Guiana) are redescribed and are here transferred to the genus Etiennea Matile-Ferrero; one species is synonymized and 12 spp. are described as new. Lectotypes have been designated for Etiennea kellyi (Brain) and E. montrichardiae (Newstead). Although not considered to be congeneric with P. castilloae, P. tsaratananae Mamet and P. crustuliforme (Green) are left in Platysaissetia.

Houck, L.G., Jenner, J.F., Moreno, D.S. & Mackey, B.E. 1989. Permeability of polymer film wraps for citrus fruit fumigated with hydrogen cyanide to control California red scale. Journal of the American Society for Horticultural Science 114(2):287-292.

Permeability to the postharvest fumigant hydrogen cyanide (HCN) varied markedly among 13 plastic film-wrapping materials; permeability was determined by comparing Aonidiella aurantii surviving fumigation on film-wrapped and nonwrapped, insect-infested, fruit.

Houck, M.A. & O'Connor, B.M. 1990. Ontogeny and life history of Hemisarcoptes cooremani (Acari: Hemisarcoptidae). Annals of the Entomological Society of America 83(5):869-886; ill.

Predatory stages associated with diaspidid scale insects are described for the first time; found on Lepidosaphes beckii growing on orange trees and Epidiaspis leperii on walnuts.

Howard, F.W. 1991. Ecology and control of hemipterous pests of cultivated palms. American Entomologist (Winter):217-225; ill.

Wild palms are tropical; lack dormancy mechanisms; many are economically important as source of food, fiber, building materials, etc.; among the insects feeding on them are the following scales: Comstockiella sabalis (on Sabal palmetto), Phoenicoccoccus marlatti (on date palms), Parlatoria blanchardi (on date palms), Aspidiotus destructor (on coconut palms), Chrysomphalus aonidum, Pseudaulacaspis cockerelli, Aonidiella orientalis, Ischnaspis longirostris and Vinsonia stellifera (on coconut palms).

Hoy, M.A. 1990. 3.6.3.2 Genetic Improvement of Natural Enemies of Armored Scale Insects. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 441-451. (World Crop Pests.)

At present no improved strains of natural enemies are used in a control program; possibilities are discussed; examples of breeding programs on Aphytis are given (temperature & pesticide resistance); hybridization and recombinant RNA techniques are discussed; factors limiting genetic improvement projects are listed.

Hu, J.-l. 1987. A new species of Ischnafiorinia (Coccoidea: Diaspididae). Contr. Shanghai Inst. Entomol. 7:135-137; ill. (In Chinese, English abstract)

Adult female, and first and second instar larvae of Ischnafiorinia bambusicola Hu, new sp. are described; found on leaves of Bambusa sp. in Guanxian, Sichuan; compared to I. bambusae.

Huang, B. 1987. A further investigation of the citrus root mealybug, Rhizoecus kondonis Kuwana and citrus ground mealybug, Geococcus citrinus Kuwana (Homoptera: Pseudococcidae). Journal of Fujian Agricultural College 16(1):83-86. (In Chinese, English abstract)

These pests of citrus are found mainly in Fujian, China; proposals for quarantine and control.

Huang, J. & Huang, B. 1988. Bionomics of Ceroplastes floridensis Comstock (Hom. Coccidae) and its Hymenopterous parasites (Hym., Chalcidoidea). Journal of Fujian Agricultural College 17(1):31-37. (In Chinese, English abstract)

Important pest of citrus and other economic plants; biology; often confused with C. japonicus; 8 Hymenopterous parasites found from Aphelinidae, Encyrtidae, Eulophidae and Pteromalidae families.

Huffaker, C.B. 1990. 2.6.3 Effects of Environmental Factors on Natural Enemies of Armored Scale Insects. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 205-220; ill. (World Crop Pests.)

Abiotic factors are discussed which influence the effectiveness of natural enemies of Diaspididae, including climate-host-natural enemy relationships, temperature, humidity and precipitation, shading and light, pesticides, diapause syndrome and synchronization; biotic factors covered are: host plant influence, host scale insect influences, comparison of host versus climatic influences, subsidiary foods and alternative or alternate hosts, interspecific competition, hyperparasitoids.

Huffaker, C.B. & Gutierrez, A.P. 1990. 2.6.1 Natural Enemies and Prey Population Regulation. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 185-195; ill. (World Crop Pests.)

Control of scales by parasites to illustrate diverse mechanisms at work; topics covered are behavioral and reproductive responses, biological control and population regulation, percentage parasitization and regulative power, contemporaneously or sequentially acting mortality factors, competitive displacement, effects of predatory host-feeding by adult female parasitoids, and climatic factors and prey-predator (parasitoid) relationships.

Huffaker, C.B. & Gutierrez, A.P. 1990. 3.6.5 Evaluation of Efficiency of Natural Enemies in Biological Control. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 473-495; ill. (World Crop Pests.)

Influence of climatic factors on predator-prey relationships; methods of evaluating effectiveness such as empirical methods and modelling.

Huffaker, C.B. & Rosen, D. 1990. 2.6.2 The Attributes of Effective Natural Enemies. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 197-204; ill. (World Crop Pests.)

Four basic attributes of successful natural enemies reviewed--population searching ability, fitness and adaptability, power of increase, and prey specificity and discrimination; searching effectiveness considered as the most meaningful measure of an effective natural enemy and seems necessarily to be a function of host or prey density.

International Commission on Zoological Nomenclature, L. 1991. Opinion 1627 Saissetia Deplanche, 1859 (Insecta, Homoptera): Lecanium coffeae Walker, 1852 designated as the type species. Bulletin of Zoological Nomenclature 48(1):72-73.

Species name Saissetia coffeae suppressed.

International Commission on Zoological Nomenclature, L. 1991. Opinion 1877 (Insecta, Homoptera): Fonscolombia graminis Lichtenstein, 1877 fixed as the type species. Bulletin of Zoological Nomenclature 48(3):266-267.

Generic and specific names Tychea graminis Koch suppressed.

Ishchenko, R.I., Bichina, T.I. & Kovalev, B.G. 1988. Attractiveness of 3,7-dimethyl-2,7 octadienyl propionate and its positional isomer for San Jose scale males. Khemoretseptsiya Nasekomykh (No. 10):99-101. (In Russian, English abstract)

Beta-isomer propionate (geranyl propionate) was shown to be attractive and did not inhibit the activity of alpha-geranyl propionate to a great extent when its content was lower than 30%.

Ishchenko, R.I., Veselovskii, V.V., Moiseenkov, A.M., Cheskis, B.A. & Kovalev, B.G. 1989. Synthesis of the racemic sex pheromone of Pseudococcus comstocki. (USSR) Chemistry of Natural Compounds 25(1):118-119.
[Translated from Khimiya Prirodnykh Soedinenii, No. 1, pp. 132-134, Jan-Feb, 1989.]

The synthesis of the acetate of 2,6-dimethylhepta-1,5-dien-3-01 -- the sex pheromone of the Comstock bug -- has been carried out by condensing isobutenyllithium with 3,4-epoxy-2-methylbut-1-ene and acetylating the 2,6-dimethylhepta-1,5,-dien-1-01 formed. The overall yield of pheromone was 46%.

Iziquel, Y., Le Ralex, A. & Nenon, J.-P. 1988. Epidinocarsis lopezi (Hymenoptera: Encyrtidae): ovipositor, types of stings and the nature of the parasitism of Phenacoccus manihoti (Homoptera, Pseudococcidae). (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 129-163; ill. (In French, English abstract)

Female is able to make three different types of stings: without oviposition, nutritional and with oviposition; parasitism induced by this sp. is of the solitary type (60 to 80 pecent under experimental conditions); discussion of possible functions of the sensory equipment and glands.

Iziquel, Y. & Le Ru, B. 1988. The influence of hyperparasitism on the populations of a hymenopterous encyrtidae, Epidinocarsis lopezi (De Santis), exotic parasitoid of the cassava mealybug, Phenacoccus manihoti Mat.-Ferr. introduced into the Congo. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 75-98. (In French, French & English abstract)

Low rates of parasitism exhibited by E. lopezi in the field; high mortality exerted by the hyperparasites.

Jarjes, S.J., Al-Mallah, N.M. & Abdulla, S.I. 1989. Insects and mites pests survey on rose-bay shrubs in Mosul Region with some ecological and biological aspects of (Nipaecoccus viridis New.) and (Parlatoria crypta M.) on rose-bay shrubs. (Iraq) Mesopotamia Journal of Agriculture 21(3):29. (In Armenian, English abstract)

5 insect and mite species recorded on Nerium oleander including P. crypta for the first time in Iraq.

Jones, R.N. 1991. B-Chromosome drive. (Great Britain) American Naturalist 137(3):430-442; ill.

The view of B-chromosome polymorphisms that is coming into favor resembles the so-called "parasitic" model. There has been no success in ascribing an adaptive role to B's in terms of phenotypic advantage, effects of variability, etc. Drive seems to be the main force generating B-chromosome polymorphisms.

Jun, Y., Bridge, P.D. & Evans, H.C. 1991. An integrated approach to the taxonomy of the genus Verticillium. (Great Britain) Journal of General Microbiology 137: 1437-1444.

The taxonomic relationship among 64 isolates of Verticillium was investigated using morphological, physiological and biochemical characters; includes 11 scale insects, predominantly tropical.

Kahali, N. 1990. An index to Applied Entomology and Phytopathology. (Iran) Applied Entomology and Phytopathology 1-53(1946-1985):58 pp. (In English & Farsi)

This bilingual index consists of a bibliography of insect research (173 works cited) published in Plant Pests and Diseases and organized alphabetically by author. It includes a keyword index to titles in the bibliography. Only two works refer to scale research: Habibian, A., Biology and control of San Jose scale in Guilan province (1980, 48(2): 127-134), and Seghatoleshlami, H., Some complementary studies on San Jose scale in Bandar Anzali (Guilan province) (1980, 48(2): 149-154).

Kiyindou, A. 1988. Recovery in Congo of Hyperaspis raynevali (Col. Coccinellidae), a predator introduced for the control of the Cassava Mealybug, Phenacoccus manihoti (Hom. Pseudococcidae). (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 211. (In English)

H. raynevali introduced in Congo for control of P. manihoti from Guyana where they developed as predators of P. herreni on cassava; later they were collected from Planococcus citri on Nauclea latifolia.

Kiyindou, A. 1988. Thermic threshold of development for three Coccinellid predators of the cassava mealybug in the Congo. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 187-200. (In French, English abstract)

Host: Phenacoccus manihoti; lower threshold temperatures were computed using the thermal constant method; the exotic sp. Hyperaspis raynevali shown to have lower limiting temperature than the local species H. senegalensis hottentotta and Exochomus flaviventris.

Kiyindou, A. & Fabres, G. 1988. Capacity for increase in Hyperaspis raynevali (Col.: Coccinellidae) a predator introduced to the Congo for biological control of populations of Phenacoccus manihoti (Hom.: Pseudococcidae). (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 201-209. (In French, English abstract)

[Also published in Entomophaga, 1987, 32(2):181-189.]

Biology studied; capacity for increase is higher than that of the local species, Exochomus flaviventris & Hyperaspis senegalensis hottentotta; development rate much reduced at temperatures lower than 25 degrees C; high embryonic mortality is recorded at temperatures ranging from 20 to 30 degrees C.

Komosinska, H. 1987. Occurrence of scale insects (Homoptera, Coccoidea) on trees and shrubs of forests in the Warsaw environs. Annals of Warsaw Agricultural University - SGGW-AR (21):105-116. (In English, Polish abstract)

Discussion of frequency of species, density of colonies and analysis of single-host groupings; 14 scale species mentioned.

Komosinska, H. 1987. Occurrence of scale insects (Homoptera, Coccoidea) on trees and shrubs of the Warsaw parks. Annals of Warsaw Agricultural University - SGGW-AR (21):95-103. (In English, Polish abstract)

Discussion of frequency of species, frequency of species of different feeding specialization range, density of colonies and analysis of co-occurrence of species with single host plants; 19 scale species mentioned.

Kosztarab, M. 1990. 3.1.2 Economic Importance. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p.307-311; ill. (World Crop Pests.)

Review of economic importance of Diaspididae; main emphasis on pests, but some information given on diaspidids used as biological control agents; some discussion of how damage is caused and what the results are for the plant; method of ranking the degree of infestation by scales is given; also discussion of assessing monetary value of losses from scales with some examples.

Kozar, F. 1990. 3.4.1 Forecasting. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 335-340. (World Crop Pests.)

Five major categories of forecasting are listed: 1) distribution and spatial forecasting, 2) population dynamic forecasting, 3) phenological forecasting, 4) warning and monitoring systems, 5) forecasting of damage; each is discussed in detail with Quadraspidiotus perniciosus as the main example.

Kozar, F. 1990. 3.4.2 Sampling and Census-Taking. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 341-347. (World Crop Pests.)

Uses of survey reviewed; table showing most common feeding sites (plant parts) for 17 important pest scale species; review of sampling methods for fields or orchards and for individual trees; discussion of ways to present data; concludes that reliable collecting and surveying techniques have not been devised yet.

Kozar, F. 1990. 3.9.7 Deciduous fruit trees. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 593-602. (World Crop Pests.)

7 main diaspidid pests of fruit trees, berry bushes, and grapevine are briefly discussed; chemical control, natural enemies, quarantine measures, plant nutrition, and plant resistance.

Kozar, F. 1991. New genus and species of scale insects in Italy (Homoptera; Coccoidea; Pseudococcidae). Boll. Zool. agr. Bachic. Ser. II, 23(1):39-44. (In English, Italian abstract)

The genus Pellizzaricoccus and new species Pellizzaricoccus gabrielis are described from Italy.

Kozar, F. 1991. Trends in the speciation of some Homoptera groups in association with host plants. In Symposia Biologica Hungarica, edited by A. and T. Jermy (Eds.) Szentesi. Budapest, Hungary: July 3-8, 1989. Budapest, Hungary: Akademiai Kiado; 491-494.

Only 20% of some homopteran groups have been described after 1960 -- evidence that our taxonomic knowledge is still very incomplete and discussion about trends speculative; 87% of Diaspididae species of the world show very restricted distribution and almost all newly described species are rare and monophagous; speciation in some groups of insects is determined mostly by historical events, ecological crises (glaciation), geographical and other factors of isolation, and by genetic possibilities.

Kozar, F. & Drozdjak, J. 1990. Data to the scale insect (Homoptera: Coccoidea) fauna of the Batorliget nature reserves. In The Batorliget Nature Reserves -- After forty years. S. Mahunka, Ed. Budapest: Hungarian Natural History Museum. p. 361-367.

30 scale insect species reported; 14 new records for the region; Exaeretopus mahunkai new species record; Lecanopsis terrestris and Vittacoccus longicornis new to Hungarian fauna; distributions; host plants; instars; species density.

Kugusheva, L.I., Rozengart, V.I., Kozenashevá, L.Y. & Kolesova, V.A. 1990. Comparative studies of the effects of esters of vinylphosphoric acid on the activity of cholinesterase and carboxylesterase from mammals and arthropods. 26(1):30-34. (In Russian, English abstract)

Pseudococcus maritimus mentioned.

Kumar, R. 1989. Biology and management of root and tuber pests in tropical Africa. (Nigeria) Discovery and Innovation 1(4):44-49.

Among pests of cassava, yams and sweet potatoes, 7 scale species mentioned.

Lagowska, B. 1987. Chalcid (Hymenoptera) parasites of Pulvinaria betulae (L.), Parthenolecanium corni (Bouche) and Eulecanium coryli (L.) (Homoptera, Coccidae). Polskie Pismo Entomologiczne [Bulletin Entomologique] 57(2):383-398. (In Polish, English abstract)

19 chalcidoid species were reared; Blastrix confusa on P. corni, Metaphycus punctipes on P. betulae, and Blastotrix sericea and Microterys duplicatus on E. coryli.

Lagowska, B. 1990. Rhizaspidiotus canariensis (Lindinger) (Homoptera Diaspididae) new to the Polish fauna. Polskie Pismo Entomologiczne [Bulletin Entomologique] 60: 261-264. (In English, Polish abstract)

This species found on Aster amellus; distribution; biology.

Liber, H. & Niccoli, A. 1988. Observations on the effectiveness of an attractant food spray in increasing Chrysopid predation on Prays oleae (Bern.) eggs. Redia 71(2):467-482.

Chrysoperla carnea is attracted to the honeydew produced by Saissetia oleae, which not only serves as nourishment, but is also a prime food for the production of eggs, with oviposition generally occurring in feeding areas.

Lit, I.L. 1988. Records of the Lepidosaphedine genus Andaspis MacGillivray (Diaspididae, Coccoidea, Hemiptera) in the Philippines. Philipp Entomol 7(4): 453-454; ill.

34 species occur in this genus worldwide; mostly from southeast Asia, Japan, China, Taiwan, Australia & Africa; first time records of this genus in the Philippines: A. hawaiiensis and A. mackieana.

Lit, I.L., Jr. 1990. Some Philippine parlatoriine scale insects (Diaspididae, Coccoidea, Hemiptera). Philippine Entomology 8(1):627-641; ill.

Redescriptions and new records for the Philippines: Parlatoria camelliae and P. morrisoni; distribution; hosts; key to genera and species.

Lit, I.L., Calilung, V.J. & Villacarlos, L.T. 1990. Notes on mealybugs and scale insects (Coccoidea, Hemiptera) of cassava (Manihot esculenta Crantz). Philippine Entomology 8(1):707-708.

Two previously unrecorded scale insects on cassava in the Philippines reported: Pseudococcus elisae and Pseudaulacaspis pentagona.

Liu, T.S. & Tao, C.C. 1988. An unrecorded rice mealybug of Taiwan. Bull Taichung Dist Agric Improve Stn 20:61-66; ill. (In Chinese, English abstract)

Heterococcus rehi recorded for the first time in Taiwan and mainland China; synonymy; description; compared to Dysmicoccus boninsis.

Liu, T.-X. & Tippins, H.H. 1988. Three new species of Neoquernaspis (Homoptera: Coccoidea: Diaspididae) from Nepal. (39.) Insecta Matsumurana 39 (n.s.):35-48; ill. (Scientific Report No. 33.)

N. takagii, N. howelli and N. beshearae described and illustrated; hosts.

Lohr, B., Varela, A.M. & Santos, B. 1990. Exploration for natural enemies of the cassava mealybug, Phenacoccus manihoti (Homoptera: Pseudococcidae), in South America for the biological control of this introduced pest in Africa. Bulletin of Entomological Research 80(4):417-425.

Argentina, Bolivia, Brazil and Paraguay were searched for this species; 18 natural enemies found; the most important include Epidinocarsis lopezi, Hyperaspis notata, Diomus spp. and Ocyptamus spp.

Longo, S., Marotta, S., Russo, A. & Tranfaglia, A. 1989. Contribution to knowledge of the coccids (Homoptera, Coccoidea) from Sicily with the description of a new species. (Contributo alla conoscenza della coccidofauna (Homoptera, Coccoidea) della Sicilia con la descrizione di una nuova specie.) Entomologica (Bari) 24(30-XII):163-179; ill. (In Italian, English abstract)

Biological and taxonomical observations of Coccoidea in Sicily; morphology, hosts, and distribution of Hypogeococcus festerianus, Phenacoccus aceris, P. graminicola, Rhizoecus cacticans, R. falcifer, Vryburgia rimariae, Rhizopulvinaria grassei, Bambusaspis bambusae, Rhizococcus cynodontis, Peliococcus cycliger, P. oleae and Phenacoccus silvanae.

Longo, S., Russo, A. & Siscaro, G. 1989. Bio-ethological observations on Quadraspidiotus perniciosus (Homoptera: Diaspididae) in Eastern Sicily peach orchards. (Rilievi bio-etologici su Quadraspidiotus perniciosus (Homoptera: Diaspididae) in pescheti della Sicilia orientale.) Tecnica Agricola 41(3):3-11. (In Italian, English abstract)

Biology; discussion of natural enemies, Encarsia perniciosi and Aphytis proclia.

Lu, C.-r. & Zhen, C. 1989. Studies on the biology of Matsucoccus shennongjiaensis Young et Lu (Homoptera: Margarodidae). Scientia Silvae Sinicae 25(6):577-582. (In Chinese, English abstract)

Pest of Pinus armandi; biology.

Lucke, V.E. 1990. Phytosanitary pre-inspections of pomaceous fruits for San Jose scale (Quadraspidiotus perniciosus Comstock) carried out in Chile. (Phytosanitare voruntersuchungen von kernobst auf besatz mit der san-Jose-Schildlaus (Quadraspidiotus perniciosus Comstock) in Chile.) Gesunde Pflanzen 42(3):97-102; ill. (In German, English abstract)

Description and evaluation of phytosanitary pre-inspections of fruits to be exported from Chile to Europe.

Mani, M. 1989. A review of the pink mealybug -- Maconellicoccus hirsutus (Green). Insect Science and its Application 10(2):157-167. (In English, French abstract)

Occurs in more than 13 countries; major pest in Egypt and India; biology, associated with ants; found on 45 host plants from families (listed); 16 parasitoids and 31 predators listed; physical, chemical and biological control discussed.

Mani, M. & Krishnamoorthy, A. 1990. Evaluation of the exotic predator Cryptolaemus montrouzieri Muls. (Coccinellidae, Coleoptera) in the suppression of green shield scale Chloropulvinaria psidii Maskell (Coccidae, Hemiptera) on guava. (India) Entomon 15(1-2):45-48.

This predator is a voracious feeder of this scale, consuming 3766 eggs in its larval development of 17.60 days under laboratory conditions; effective for biological control in the field.

Mani, M., Krishnamoorthy, A. & Singh, K.M. 1990. The impact of the predator, Cryptolaemus montrouzieri Mulsant, on pesticide-resistant populations of the striped mealybug, Ferrisia virgata (Ckll.) on guava in India. Insect Science and its Application 11(2):167-170. (In English, French abstract)

In addition to C. montrouzieri, Aenasius advena and Scymnus coccivora are effective biological control agents for F. virgata in guava orchards.

Mani, M. & Thontadarya, T.S. 1988. Studies on the safety of different pesticides to the grape mealybug natural enemies, Anagyrus dactylopii (How.) and Scymnus coccivora (Ayyar). Indian Journal of Plant Protection 16(2):205-210.

Diochlorvos, diazinon, phosalone and fish oil rosin soap were found non-toxic to A. dactylopii; all insecticides tested were harmful to A. coccivora; copper oxychloride, mancozeb, sulphur, carbendazim, Bordeaux mixture and difocol were safe to both the natural enemies of Maconellicoccus hirsutus.

Marotta, S. Biological observations on Spilococcus mammillariae (Bouche) (Homoptera: Pseudococcidae) on cacti in Campania. (Note biologiche su Spilococcus mammillariae (Bouche) (Homoptera: Pseudococcidae) su piante grasse in Campania.) Proceedings of the Sixteenth Italian National Congress of Entomology (Atti XVI Congresso Nazionale italiano di Entomologia). Bari - Martina Franca (Ta): September 23-28, 1991. 735-739. (In Italian, English abstract)

This mealybug lives only in greenhouses on cacti and succulent plants; widely distributed in several Italian regions; common in Campania, especially Naples; biology; host plants include Cereus sp., Astrophytum asterias, A. capricorne, Cereus peruvianus monstruosus, Chamaecereus silvestrii, Coryphanta sp., Crassula sp., Echinopsis leucantha, Ferocactus latispinus, Gymnocalicium mihanovichi, Mammillaria compressa, M. rhodantha, Melocactus sp., and Webelmannia pseudopectinifera.

Marotta, S. & Garonna, A.P. New and little known Homoptera Coccoidea of cacti and succulent plants in Italy. (Homoptera Coccoidea nuovi e poco conosciuti delle piante grasse in Italia.) Proceedings of the Sixteenth Italian National Congress of Entomology (Atti XVI Congresso Nazionale italiano di Entomologia). Bari - Martina Franca (Ta): September 23-28, 1991. 741-746. (In Italian, English abstract)

16 species of scale are recorded from cacti and succulent plants in Italy; Eriococcus coccineus and Selenaspidus albus reported for the first time; about half are economically important in greenhouses of Campania; distribution; hosts; pest status of Hypogeococcus festerianus, Vryburgia rimariae, Eriococcus coccineus and Selenaspidus albus given.

Marutani, M. & Muniappan, R. 1990. Use of Adelencyrtus oceanicus (Hym.: Encyrtidae) for controlling the red coconut scale, Furcaspis oceanica (Hom.: Diaspididae) in Guam. In FFT-NARC International Seminar: the Use of Parasitoids and Predators to Control Agricultural Pests. Tukuha Science City, Ibaraki-ken, Japan: October 2-7, 1989. Tukuba-gun, Japan: National Agricultural Research Centre (NARC); 1 p. [Abstract]

Distribution of scale species; description of biological control project.

Masoodi, M.A., Bhat, A.M. & Koul, V.K. 1989. Toxicity of insecticide to adults of Encarsia (= Prospaltella) perniciosi (Hymenoptera: Aphilinidae). Indian Journal of Agricultural Sciences 59(1):50-52.

This species helps control San Jose scale (Quadraspidiotus perniciosus) with dormant spraying of diesel-oil emulsion.

Matile-Ferrero, D. 1989 (1990). Fiorinia japonica (Kuwana), mealybug newly introduced into France, and description of its second instar male (Hom. Coccoidea Diaspididae). (Sur Fiorinia japonica (Kuwana), cochenille nouvellement introduite en France et description de sa larve male du deuxienne stade (Hom. Coccoidea Diaspididae).) (France) Bulletin de la Societe entomologique de France 94(7-8):205-211; ill. (In French, English abstract)

Recently introduced into France on imported ornamental bonsai Juniper from Taiwan; two keys given: one to separate females of four related economic species living on conifers and yews (F. externa, F. japonica, F. pinicola & F. vacciniae) and the other to separate the second instar male of F. externa, F. japonica & F. pinicola.

McClain, D.C., Rock, G.C. & Woolley, J.B. 1990. Influence of trap color and San Jose scale (Homoptera: Diaspididae) pheromone on sticky trap catches of 10 aphelinid parasitoids (Hymenoptera). Environmental Entomology 19(4):926-931.

10 parasitoid species collected on traps: Ablerus clisiocampae, Aphytis diaspidis, Encarsia sp., A. melanostictus, Coccobius sp., Coccophagoides murtfeldtae, E. aurantii, E. perniciosi, Marietta carnesi and M. mexicana; red, black and yellow traps with and without pheromones compared.

McClain, D.C., Rock, G.C. & Stinner, R.E. 1990. San Jose scale (Homoptera: Diaspididae): Simulation of seasonal phenology in North Carolina orchards. Environmental Entomology 19(4):916-925.

Pest of deciduous tree fruits in most fruit growing regions of the US; timing of chemical control programs considered; orchard temperatures and pheromone trap catch data and crawler hatch for nine orchard-years were used to validate the accuracy of physiological time models in simulating the time intervals for one generation between male flight peaks, and crawler peaks, as well as the interval between male flight peaks and crawler peaks (embryonic development) of four seasonal generations of this Quadraspidiotus perniciosus.

McClain, D.C., Rock, G.C. & Stinner, R.E. 1990. Thermal requirements for development and simulation of the seasonal phenology of Encarsia perniciosi (Hymenoptera: Aphelinidae), a parasitiod of the San Jose scale (Homoptera: Diaspididae) in North Carolina orchards. Environmental Entomology 19(5):1396-1402.

Quadraspidiotus perniciosus (Comstock) attracts this endoparasitoid with pheromones.

McClure, M.S. 1990. Cohabitation and host species effects on the population growth of Matsucoccus resinosae (Homoptera: Margarodidae) and Pineus boerneri (Homoptera: Adelgidae) on red pine. Environmental Entomology 19(3):672-676.

Performance of P. boerneri feeding on both the branches and needles of Pinus resinosae was significantly reduced by the presence of M. resinosa, which fed only on the branches. The presence of P. boerneri had no significant reciprocal effect on the fitness of M. resinosae. Competition occurred among these insects but did not limit the growth of pest populations to a level at which the host could benefit.

McFadyen, R.E. & Marohasy, J.J. 1990. Biology and host plant range of the soft scale, Steatococcus new species (Hem.: Margarodidae) for the biological control of the weed Cryptostegia grandiflora (Asclepiadaceae). Entomaphaga 35(3):437-439. (In English, French abstract)

Studies on biology and host plant range showed colonies could survive for up to 6 months on some genera in the Apocynaceae and indefinitely on many genera in the family Asclepiadaceae; therefore it was rejected as a biological control agent for C. grandiflora, a serious weed in northern Queensland, Australia.

McLaren, G.F. 1989. Phenology of oystershell scale Quadraspidiotus ostreaeformis (Curtis) in Central Otago. New Zealand Journal of Crop and Horticultural Science 17(3):215-219.

Biology; found on Malus sp. and Prunus domestica; not a serious pest but a quarantine problem for exported fruit because of its similarity to Comstockaspis perniciosus; parasites include Aphytis albidus and Encarsia citrina.

McLaughlin, J.R., Heath, R.R. & Ashley, T.R. 1990. Periodicity of pheromone release from female white peach scale. Physiological Entomology 15(2):193-197.

Sex pheromone is released by newly mature females of Pseudaulacaspis pentagona to correspond with the daily eclosion rhythm of males; it is not released during the scotophase; when sexually mature females remain unmated for 5 days, the release of pheromone begins earlier in the day than it does with newly mature females.

McNamara, J.E. C. & Humble, L.M. 1991. First Canadian record of Rhyzobius lophanthae (Blaisdell) (Coleoptera: Coccinellidae). Coleopterists' Bulletin 45(2):196-197.

Synonymy; description; distribution; hosts Carulaspis juniperi and Saissetia oleae on Sequioadendron giganteum.

Mendel, Z., Carmi, E. & Podoler, H. 1991. Relations between the genera Matsucoccus (Homoptera: Margarodidae) and Elatophilus (Hemiptera: Anthocoridae) and their significance. (Israel) Annals of the Entomological Society of America 84(5):502-507.

Data on the prey and host range of the 18 known species of the genus Elatophilus are discussed; there is sufficient data to hypothesize an almost worldwide linkage among the triad Elatophilus, Matsucoccus and Pinus; this may indicate the occurrence of Matsucoccus where rare species of Elatophilus are recorded.

Mendel, Z., Podoler, H. & Rosen, D. 1990. 2.7.4 Analysis of the Gut Contents of Predators. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 289-290; ill. (World Crop Pests.)

A procedure is given for dissecting the coccinellid predator Chilocorus bipustulatus; the mid-gut contained clearly recognizable parts of prey; identification could be made to at least order and family, and sometimes to genus and species; the mid-gut contents show what prey were consumed during the 2 days prior to dissection.

Mendel, Z., Zehavi, A. & Zeidan, S. 1991. Palaecoccus fuscipennis Burm. (Homoptera: Margarodidae), a new pest of pines in Israel. (Israel) Phytoparasitica 19(1):83.

Minor pest of Pinus brutia, P. halepensis, P. pinea, P. pinaster, P. silvestris and Cedrus atlanticus in Mediterranean countries, central Europe and, now, in Israel; copious honeydew produced; natural enemies include Rodolia cardinalis, Orius minutus, Raphidia syriaca, Chrysoperla carnea & Cryptochaetum buccatum.

Meyer, J.R. & Nalepa, C.A. 1990. Effect of dormant oil treatments on white peach scale (Homoptera: Diaspididae) and its overwintering parasite complex. Journal of Entomological Science 26(1):27-32.

Oil treatments resulted in significant reductions in the emergence of adult hymenopteran parasites of Pseudaulacaspis pentagona; however, mortality was not complete and orchard was repopulated in spring.

Michelakis, S. 1990. The inflence of pests and diseases on the quantity and quality of olive oil production. Olivae 67(30):38-40.

Types of damage to oil varieties discussed; among the pests discussed are five scale species: Saissetia oleae, Aspidiotus nerii, Parlatoria oleae, Lepidosaphes ulmi and Pollinia pollini; damage discussed.

Millar, J.G. 1989. Application of silylcupration of alkynes to stereo- and regiospecfic formation of trisubstituted alkenes. A short synthesis of yellow scale pheromone. Tetrahedron Letters 30(37):4913-4914.

A technique for synthesizing the sex pheromone of Aonidiella citrina is described.

Miller, D.R. 1991. Scale Insects (Coccoidea, Homotera). In Insect and Mite Pests in Food: an Illustrated Key (Volume 2). Gorham, J. Richard Washington, D.C.: Superintendant of Documents, U.S. Government Printing Office. p. 421-448; ill. (Agriculture Handbook No. 665.)

General description of scales to distinguish them from other Insecta and from other homopterous insects; only three of 15 families (U.S.) are likely to be found in food (usually citrus, tropical fruits, deciduous-tree fruits, and grapes): Pseudococcidae (mealybugs), Diaspididae (armored scales) and Coccidae (soft scales); key, distributions and illustrations of adult females of 23 species provided.

Miller, D.R. 1991. Systematic analysis of Acanthococcus species (Homoptera: Coccoidea: Eriococcidae) infesting Atriplex in western North America. Proceedings of the Entomological Society of Washington 93(2):333-355; ill.

Salt bush (Atriplex spp.) is important source of forage for livestock at critical times of the year; salt bush spp. are declining and suffering dieoff; insect pests include Acanthococcus spp.; seven spp. mentioned including three new spp.; key to genus; descriptions; hosts; distributions.

Miller, D.R. & Davidson, J.A. 1990. 3.1.1 A List of the Armored Scale Insect Pests. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 299-306; ill. (World Crop Pests.)

10 references were used to compile a list of 199 pest Diaspididae; scientific name; common name (if known); most serious pests are marked; the references were chosen based on the following criteria: provided data on economic importance, included a large number of armored scale species, and treated different geographic areas of the world; species on this list represent about 12% of the estimated world fauna of Diaspididae.

Miller, D.R. & Miller, G.L. 1992. Systematic analysis of Acanthococcus (Homoptera: Coccoidea: Eriococcidae) in the western United States. Transactions of the American Entomological Society 118(1):1-106; ill.

The first detailed treatment of the Acanthococcus species of the western U.S.; 33 species includes 7 that are new to science; keys; descriptions; hosts; distributions; illustrations.

Moffitt, L.J. & Baritelle, J.L. 1990. 3.4.5 Economic Thresholds. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 357-362. (World Crop Pests.)

Comparison of entomologists' "action" threshold and economists' "economic" threshold; algebraic equations given for a simple pest-crop model; various manipulations of the model illustrate derivation of an action threshold; an efficiency-based action threshold is developed through input into the initial equations.

Moiseenkov, A.M., Ishchenko, R.I., Veselovskii, V.V., Odinokov, V.N., Polunin, E.V., Kovalev, B.G., Cheskis, B.A. & Tolstikov, G.A. 1989. Synthesis of alpha-neryl and alpha-geranyl propionates - components of the sex pheromone of San Jose Scale. Chemistry of Natural Compounds 25(3):366-368.
[Translated from Khimiya Prirodnykh Soedinenii, No. 3, pp. 422-424, May-June, 1989.]

An effective synthesis of alpha-neryl and alpha-geranyl propionates has been performed by the two-stage E/Z-C5 homologization of 3-methylbut-3-en-1-yl iodide. The San Jose scale is also known as Quadraspidiotus perniciosus.

Morales, C.F. 1988. The occurrence of latania scale, Hemiberlesia lataniae (Signoret) (Hemiptera: Diaspididae), in New Zealand. New Zealand Journal of Experimental Agriculture 16(1):77-82; ill.

This species is now established in the North Island of New Zealand; the significance of this pest and methods of distinguishing it from Hemiberlesia rapax are discussed.

Muniappan, R. & Marutani, M. 1989. Biology and biological control of the red coconut scale, Furcaspis oceanica (Lindinger). In Tropical and Subtropical Agricultural Research Under PL 89-106. Special Research Grants. Progress and Achievements. The Pacific Basin Group. Honolulu, Hawaii: University of Hawaii at Manda. p. 17-18; ill.

Endemic pest of coconut in the Caroline and Marshall Islands; effectively suppressed by Adelencyrtus oceanicus and Rozanoviella sp.; introduced to Guam.

Murdoch, W.W., Luck, R.F., Walde, S.J., Reeve, J.D. & Yu, D.S. 1989. A refuge for red scale under control by Aphytis: structural aspects. Ecology 70(6):1707-1714.

Aonidiella aurantii populations sampled in eight grapefruit trees in southern California; interior of trees an area of partial refuge from parasitism by Aphytis melinus and Encarsia.

Myartseva, S.N. & Kharchenko, G.A. 1988. Parasitoid complex of Dysmicoccus multivorus (Kir.) in Turkmenia. Izvestiya Akademii Nauk Turkmenskoi SSR. Seriya Biologicheskikh (1):37-43; ill. (In Russian, English abstract)

Natural enemies include 12 species of parasites and predators including Leptomastix flava, Anagyrus diversicornis, Leptomastidea rubra and Ericydnus robustior.

Nagarkatti, S. & Sankaran, T. 1990. 3.9.3 Tea. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 553-562. (World Crop Pests.)

Many diaspidids occur on tea, but rarely become serious pests, probably because pesticides use has been minimal and natural enemies have been conserved; different species of scales prefer different feeding sites on the plant; economic importance, biology, natural enemies, and chemical control are discussed; tables list diaspidids collected from tea with country in which they occur.

Nanda, P.K. & Ghose, S.K. 1989. Descriptions of all instars of the mealybug Rastrococcus iceryoides (Green) (Homoptera: Pseudococcidae). (India) Environment & Ecology 7(2):329-336; ill.

Reared on Solanum tuberosum; key to various instars; males compared to Coccidohystrix insolita, Maconellicoccus hirsutus and Ferrisia virgata; other instars compared to Phenacoccus alleni ánd P. giganteus.

Nandagopal, V. & David, H. 1990. Biology of a leaf scale insect Greenaspis decurvata Green (Homoptera: Diaspididae) in sugarcane. (India) Entomon 15(1-2):63-68; ill.

New host record for this region; previously recorded from lemon grass.

Narasimham, A.U. 1990. Field diagnostic characters of some Rastrococcus species (Homoptera: Coccoidea: Pseudococcidae) occurring in India. Oriental Insects 24: 259-265; ill.

Descriptions of R. invadens, R. mangiferae and R. ornatus compared.

Nenon, J.-P. & Fabres, G. 1988. Study of the methodology and effectiveness of the neotropical hymenopterous encyrtidae, Epidonocarsis lopezi introduced into Africa as a parasite to control the cassava mealybug, Phenacoccus manihoti; review of French-Congo work: 1982-1987. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 119-128. (In French)

Topics covered include biology, host infestation, nature of parasitism, biology of endoparasite development, and ecology.

Nenon, J.-P., Guyomard, O. & Hemon, G. 1988. Encapsulation of eggs and larvae of Hymenoptera Encyrtidae Epidinocarsis (=Apoanagyrus) lopezi by its host Pseudococcidae Phenacoccus manihoti; effect of the temperature and its superparasitism. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 111-117; ill. (In French, English abstract)
[Also published in C. R. Acad. Sci. Paris, (1988) vol. 306, Series III, p. 325-331.]

Process of encapsulation favored by high temperatures during development and by superparasitism; belongs to the group of reciprocal relationships between the Hyenoptera and the Phenacoccus manihoti; significant physiological disruption is induced in the host after parasitization.

Neuenschwander, P. & Hammond, W.N. O. 1990. Biological control of the cassava mealybug, Phenacoccus manihoti, in Africa: review of field studies. In Integrated Pest Management for Tropical Root and Tuber Crops, edited by S. K. Hahn and F. E. Caveness. Ibadan, Nigeria: 25 - 30 October 1987. Ibadan, Nigeria: International Institute of Tropical Agriculture; pp. 42-50.
Since its accidental introduction into Africa, this species has spread to about 25 countries; parasitoid Epidinocarsis lopezi released in 17 countries for biological control; coccinellid Diomus sp. released in 12 countries but established in only Kinshasa, Zaire; Epidinocarsis diesicornis and the platygasterid Allotropa sp. also released.

Neuenschwander, P., Hammond, W.N. O., Ajuono, O., Gado, A., Echendu, N., Bokonon-Ganta, A.H., Allomasso, R. & Okon, I. 1990. Biological control of the cassava mealybug, Phenacoccus manihoti (Hom., Pseudococcidae) by Epidinocarsis lopezi (Hym., Encyrtidae) in West Africa, as influenced by climate and soil. Agriculture, Ecosystems & Environment 32(1-2):39-55.

Population data concerning the cassava mealybug, the introduced parasitoid, and indigenous antagonists were collected, together with ecological and plant growth variables; seven years after first release, nearly the entire area had been colonized by E. lopezi.

Nohara, K. & Iwata, M. 1988. Biological study of Cybocephalus gibbulus (Erichson) (Coleoptera, Cybocephaliedae), a predator of the scale insects in the citrus orchards. Proceedings of the Faculty of Agriculture (Kyushu Tokai University) 7: 25-31. (In Japanese, English abstract)

Biology of this predator on Unaspis yanonensis, the arrowhead scale.

Nohara, K. & Iwata, M. 1988. Studies on ovipositing behaviour of Chilocorus kuwanae Silvestri (Coleoptera, Coccinellidae). Proceedings of the Faculty of Agriculture (Kyushu Tokai University) 7:17-24. (In Japanese, English abstract)

Study of this predator of the arrowhead scale, Unaspis yanonensis, and other scale insects of citrus; natural enemies of this predator.

Nohara, K. & Iwata, M. 1988. Studies on ovipositing behaviour of Chilocorus kuwanae Silvestri (Coleoptera, Coccinellidae). Proceedings of the Faculty of Agriculture (Kyushu Tokai University) 7:17-24. (In Japanese, English abstract)

Study of this predator of the arrowhead scale, Unaspis yanonensis, and other scale insects of citrus; natural enemies of this predator.

Noyes, J.S. 1990. 2.4.2 Encyrtidae. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 133-166; ill. (World Crop Pests.)

Review of the members of the family Encyrtidae known to be associated with Diaspididae; taxonomy, biology, distribution, scale hosts, key to 29 genera.

Nur, U. 1990. Heterochromatization and euchromatization of whole genomes in scale insects (Coccoidea: Homoptera). In Development Supplement: Genomic Imprinting, edited by M. and Surani, A., Eds. Monk. Manchester, England: April 1990. Cambridge, England: The Company of Biologists Ltd.; 29-34; ill.
In several families of scale insects, there are no sex chromosomes and both males and females develop from fertilized eggs. However, in the eggs destined to develop into males, one genome either becomes heterochromatic (H) and genetically inactive, or is eliminated. The differential behavior of the two genomes has been attributed to 'prior conditioning' or genome imprinting.

Nurmamatov, A.M. & Bazarov, B.B. 1990. A new species of mealybug, Peliococcus darvasicus sp. n. (Homoptera: Pseudococcidae), from Tajikistan. Entomological Review 69(3):59-61; ill.
Description of this new species collected on the northern slopes of the Darvaz Range; found on the roots of Fabaceae.

Odinokov, V.N., Kukovinets, O.S., Zainullin, R.A., Tsyglintseva, E.Y., Sultanmuratova, V.R., Veselovskii, V.V., Dragan, V.A., Rubinskaya, T.Y., Cheskis, B.A., Moiseenkov, A.M. & Tolstikov, G.A. 1989. Insect pheromones and their analogs. XIX. Preparation of alpha-geranyl propionate - the main component of the sex pheromone of San Jose scale. Chemistry of Natural Compounds 25(3): 364-366.
[Translated from Khimiya Prirodnykh Soedinenii, No. 3, pp. 419-421, May-June, 1989.]
Two methods for synthesizing alpha-geranyl propionate -- a component of the sex pheromone of Quadraspidiotus perniciosus -- have been developed: the hydride reduction of the corresponding 6-chloro derivative and the electrochemical reduction of the 6-dimethylsulfonium derivative.

Okeke, J.E. 1990. Status of the cultural management component in an integrated control of the cassava mealybug (Phenacoccus manihoti Mat.-Ferr.) and green spider mite (Mononychellus tanajoa Bondar) in Nigeria. In Integrated Pest Management for Tropical Root and Tuber Crops, edited by S.K. Hahn and F. E. Caveness. Ibadan, Nigeria: 25 - 30 October 1987. Ibadan, Nigeria: International Institute of Tropical Agriculture; pp. 188-192.
Integrated pest management "package" included fertilizer, which proved most efficient, giving greater crop yields than the other components. Low K-levels in soils were associated with severe pest attack symptoms and general low soil fertility affected host plant recovery rate.

Okul, A., Bulut, H. & Zeki, C. 1987. Investigations on the biology of some species of Coccoidea (Homoptera) species injurious to apple trees in Ankara. (Anakara ili elma agaclarinda zararli bazi Coccoidea (Homoptera) turlerinin bioyolojileri uzerinde arastirmalar.) Turkiye I. Entomoloji Kongresi :13-16. (In Turkish, English abstract)
Biology of Lepidosaphes ulmi, Parthenolecanium corni and Palaeolecanium bituberculatum.

Ou, B. & Hong, G. 1990. Description of a new species of Kerria (Homoptera: Lacciferidae) in Yunnan Province. Entomotaxonomia 12(1):15-18; ill. (In Chinese, English abstract)
Adult female of Kerria yunnanensis, new species, is described; found on Dalbergia obtusifolia; compared to Kerria lacca and K. ruralis.

Palmer, J.M. & Mound, L.A. 1990. 2.2.5 Thysanoptera. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 67-76; ill. (World Crop Pests.)
Review of thrips species known to feed on armored scale insects (Diaspididae); key to 9 species of thrips (in one case a genus).

Pan, W.-Y., Tank, Z.-Y., Xia, G.-L., Lian, J.-H. & Hu, J.-L. 1987. Studies of a new destructive forest pest in South China: pine needle Hemiberlesian scale (Coccoidea: Diaspididae). Contr. Shanghai Inst. Entomol. 7:177-189. (In Chinese, English abstract)

Hemiberlesia pitysophila; economics; description of damage; life history; ecology; population dynamics; habitat; distributed in Palaearctic region; hosts include Pinus luchuensis, P. massoniana, P. ellottii, P. caribaea, P. taeda and P. thunbergii; natural enemies include Ancylopteryx octopunctata, Chrysopa kulingensis, Anystis baccarum, Cybocephalus nipponicus, Karnyothrips flavipes and Encarsia citrinus; diseases.

Park, J.D. & Kim, K.C. 1990. Host range, life cycle and natural enemies of mulberry scale (Pseudaulacaspis pentagona) on Prunus mume in southern Korea. Korean Journal of Applied Entomology 29(2):104-112. (In Korean, English abstract)

Mulberry scale; hosts include 74 species from 22 families; life cycle; population dynamics; natural enemies.

Patil, A.P., Thakur, S.G. & Mohalkar, P.R. 1988. Incidence of pests of turmeric and ginger in Western Maharashtra. Indian Cocoa, Arecanut & Spices Journal 12(1):8-9.

Among 10 pests of these crops, Aspidiotus hartii was the only scale insect recorded.

Pelletier, D.L. & Msukwa, L.A. H. 1990. The role of information systems in decision-making following disasters: lessons from the mealy bug disaster in northern Malawi. Human organization 49(3):245-254.

Discussion of the destruction of the staple food crop in Malawi due to Phenacoccus manihoti in 1986/87.

Pellizzari Scaltriti, C. 1989. Insects of medicinal plants. 2. Note: The phytophagous complex of Thymus with particular reference to scale insects. (Gli insetti delle piante officinali. 2. Nota: I fitofagi del Thymus, con particolare riferimento alle cocciniglie.) Redia 72(2):567-579; ill. (In Italian, English abstract)

Among the species reviewed are seven scale species: Puto pilosellae, Peliococcus tritubulatus, Parthenolecanium corni, Eriococcus munroi, Cerococcus cycliger, Planchonia arabidis, Quadraspidiotus labiatarum and Rhizaspidiotus canariensis; brief descriptions; hosts; distributions.

Pellizzari-Scaltriti, G. 1991. Recent Coccoidea reports for the Italian fauna. (Segnalazione di omotteri Coccoidea nuovi per l'Italia (Homoptera).) Bollettino della Societa Entomologica Italiana 123(1):16-20. (In Italian, English abstract)

Species reported new for the Italian fauna include Metadenopus festucae, Mirococcus inermis, Peliococcus armeniacus, Lecanopsis festucae, Parthenolecanium pomeranicum, Rhizopulvinaria dianthi, Pseudochermes fraxini, Kaweckia glyceriae and Asterodiaspis repugnans; geonemy; host plants.

Peng, Y.-k., Cheng, D.-d., Sheng, C.-c., Zhao, Y.-l. & Chai, B.-c. 1990. A study of Chloropulvinaria polygonata (Cockerell) in Sichuan (Coccoidea: Coccidae). Acta Entomologica Sinica 33(3):323-329. (In Chinese, English abstract)

Important citrus pest in Sichuan Province; biology; natural enemies.

Phillips, P.A. & Sherk, C.J. 1991. To control mealybugs, stop honeydew-seeking ants. California Agriculture 45(2):26-28; ill.

Recent increases in obscure mealybug (Pseudococcus affinis) infestations in central-coast vineyards have been associated with Argentine ant (Iridomyrmex humilis) activity. Infestations were reduced by controlling these honeydew-seeking ants in the spring, using chemical treatments directed at the base of the vines. This control strategy avoids full coverage treatments disruptive to beneficials.

Pijls, J.W. A. M., Hofker, K.D., Van Staalduinen, M.J. & Van Alphen, J.J. M. 1990. Interspecific host discrimination and competition by Epidinocarsis lopezi and E. diversicornis, parasitoids of the cassava mealybug, Phenacoccus manihoti. In International Symposium on Crop Protection. Meded Fac. Landbouww. Rijksuniv. Gent. 405-416.

E. lopezi currently parasitizes P. manihoti in Africa; attempts to introduce E. diversicornis from South America, where it coexists with E. lopezi, have failed; various factors examined to discover cause of failure.

Podsiadlo, E. 1990. Concept of the species of Asterodiaspis variolosa (Ratzeburg, 1870) (Homoptera, Coccoidea, Asterolecaniidae). (Poland) Annales Zoologici 43(18):363-371. (In English, Polish & Russian abstract)

Synonymy (quercicola and minus); discontinuous individual variation recorded within colonies of this species is interpreted as an instance of polymorphism.

Prasad, Y.K. 1990. Discovery of isolated patches of Icerya purchasi by Rodolia cardinalis: a field study. (Australia) Entomaphaga 35(3):421-429. (In English, French abstract)

Hosts Acacia baileyana and citrus; results indicate that Rodolia cardinalis can find and destroy isolated scale colonies.

Prinsloo, G.L. 1989. The southern African species of Astymachus Howard and Rhopus Foerster (Hymenoptera: Encyrtidae). Journal of the Entomological Society of Southern Africa 52(1):129-147; ill.

Two scale species are mentioned as hosts for the encyrtids discussed here: Nipaecoccus graminus for Rhopus (Xanthoencyrtus) geminus (new sp.), and for Paracoccus burnerae for Rhopus (Xanthoencyrtus) urbanus (new sp.).

Rae, D.J. & De'ath, G. 1991. Influence of constant temperature on develoment, survival and fecundity of sugarcane mealybug, Saccharicoccus sacchari (Cockerell) (Hemiptera: Pseudococcidae). Australian Journal of Zoology 39:105-122; ill.

Generation time of S. sacchari females reared on potted cane ranged from 107 days at 20 degrees C to 25 days at 30 degrees C; results to be used in a model to simulate the population dynamics of this species in the field.

Raju, A.K., Rao, P.R. M., Apparao, R.V., Readdy, A.S. & Rao, K.K. P. 1988. Note on estimation of losses in yield of mesta due to mealy bug, Maconellicoccus hirsutus Green. (India) Jute Development Journal 8(1):34-35.

This species is one of the major pests attacking Hibiscus sabdariffa in the Badangi area of Vizianagaram district in Andhra Pradesh; biology.

Rao, P.M. & Babu, P.C. Sundara. 1990. Biology of rice mealybug (Brevennia rehi) (Hemiptera: Pseudococcidae) with refereńce to host range and varietal preference. Indian Journal of Agricultural Sciences 60(12):850-851.

Varieties of Oryza sativa, Saccharum officinarum, Pennisetum glaucum and P. purpureum were used for this trial of favored host.

Raspi, A. 1988. Preliminary notes on Entomophagous insects of Saissetia oleae (Oliv.) and Lichtensia viburni Sign. in olive groves of the Tuscan and West Ligurian Coast. (Nota preliminare sugli entomofagi di Saissetia oleae (Oliv.) e di Lichtensia viburni Sign. presenti negli oliveti della Toscana Litoranea e della Liguria Occidentale.) Frustula Entomologica n.s. 11(24):119-128; ill. (In Italian, English abstract)

Entomophagous insects discussed include Scutellista cyanea, Exochomus quadripustulatus, Chilocorus bipustulatus, Metaphycus bartletti, M. helvolus, Moranila californica, Leucopis (Leucopomyia) alticeps, L. (Leucopomyia) silesiaca & Cryptolaemus montrouzieri.

Rawat, U.S., Pawar, A.D. & Chand, R. 1989. New record of mealy bug, Drosicha dalbergiae Green and its incidence on pomegranate in Himachal Pradesh. (India) Journal of Insect Science 2(1):66-67.

This new record is one of about 45 species of insects that attacks Punica granatum; does not cause serious damage.

Rawat, U.S., Thakur, J.N. & Pawar, A.D. 1988. Introduction and establishment of Chilocorus bijugus Mulsant and Pharaoscymnus flexibilis Mulsant, predatory beetles of San Jose scale at Thanedhar areas in Himachal Pradesh. (India) Current Science 57(22):1250-1251.

Quadraspidiotus perniciosus (Hemiptera: Diaspididae) is notorious pest; grows throughout the deciduous fruit-growing regions of the world; attacks apple, plum, pear and peach in Jammu & Kashmir; Himachal Pradesh and Utter Pradesh; chemical control difficult due to high cost, waxy covering and development of insecticidal resistance; natural enemies include Chilocorus bijugus, Pharoscymnus flexibilis, Encarsia perniciosi and Aphytis proclia; comparison and success of attempts at biological control discussed.

Ray, C.H. Jr. & Williams, M.L. 1991. Two new species of Matsucoccus Cockerell (Homoptera: Margarodidae) similar to Matsucoccus alabamae Morrison. Proceedings of the Entomological Society of Washington 93(1):186-192; ill.

Adult females of M. banksianae and M. oocarpae are described and illustrated.

Ray, C.H., Jr. & Williams, M.L. 1984. Two new species of Matsucoccus (Homoptera: Margarodidae) from Arizona and Mexico with a key to species in North America. Annals of the Entomological Society of America 77(6):765-769; ill.

Key to 17 spp. of North American Matsucoccus; adult females of M. apachecae and M. leiophyllae are described and illustrated; etymology; hosts; biological notes.

Ren, H. 1988. Two new species of Aphytis from China (Hymenoptera: Aphelinidae). Entomotaxonomia 10(3-4):219-223; ill. (In Chinese, English abstract)

Aphytis chionaspis and A. acalcaratus described, natural enemies of Chionaspis cinnamomicola and Parlatoria acalcarata respectively.

Ren, S.X., Guo, Z.Z., Xiong, J.W. & He, Y.F. 1990. A life history study of Chilocorus bijugus (Col.: Coccinellidae), an important predator of the Arrowhead scale in Guizhou. Chinese Journal of Biological Control 6(2):71-73. (In Chinese, English abstract)

Phenology of this predator well synchronized with Unaspis yanonensis; successful in controlling population.

Richard, C. 1990. Transnewsteadia nepalensis, n. gen., n. sp. and Ortheziola loebli, n. sp., Ortheziidae from Nepalese litter forest (Homoptera: Coccoidea-Archaeococcoidea). (Transnewsteadia nepalensis, n. gen., n. sp., et Ortheziola loebli, n. sp., Ortheziidae de foret litiere nepalaise (Homoptera: Coccoidea-archaeococcoidea).) (Nepal) Annales de la Societe entomologique de France (N.S) 26(2):223-230; ill. (In French, English abstract)

Two new species described living in litter and humus.

Riehl, L.A. 1990. 3.5.1 Control Chemicals. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 365-392. (World Crop Pests.)

Covers fumigation with HCN, mineral oils, and synthetic organic insecticides; discussion of composition, structure, properties, mode of action, toxicity, formulation, methods of application, resistance, role in IPM, effect on natural enemies, precautions for use and re-entry into treated orchards.

Rock, G.C. & McClain, D.C. 1990. Effects of constant photoperiods and temperatures on the hibernating life stages of the San Jose Scale (Homoptera: Diaspididae) in North Carolina. Journal of Entomological Science 25(4):615-621.

The black cap phase of the first instar nymph accounted for about 85% of the hibernating life stages of Quadraspidiotus perniciosus in an apple orchard; this species hybernates in a nondiapause state of dormancy; dormancy is temperature dependent.

Rosciszewska, M. 1989. Sense organs of antennae of Ortheziidae (Homoptera, Coccinea). (Poland) Acta Biologica Cracoviensia; Series: Zoologia 31:1-18; ill.

External morphology of the antennae and their sense organs described in Orthezia urticae, Arctorthezia cataphracta, Newsteadia floccosa and Ortheziola veydovskyi.

Rose, M. 1990. 2.7.1 Sampling for Natural Enemies. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 229-234; ill. (World Crop Pests.)

Explanation of purposes and methods of sampling for natural enemies; discussion of equipment used in sampling and how to sort samples.

Rose, M. 1990. 2.7.3 Rearing and Mass Rearing of Natural Enemies. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 263-287; ill. (World Crop Pests.)

Discussion of rearing methods for newly imported parasites in the families Aphelinidae, Encyrtidae, and Signiphoridae; hosts, containers, handling techniques, environmental requirements, record keeping are covered.

Rose, M. 1990. 3.6.3.1 Periodic Colonization of Natural Enemies. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 433-440. (World Crop Pests.)

Augmentation of natural enemies; purposes; review of projects; considerations for successful augmentation; insectary requirements.

Rose, M. 1990. 3.9.1 Citrus. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 535-541. (World Crop Pests.)

Diaspididae are major pests of citrus due to great reproductive capacity, survival ability, and difficulty of chemical control; injury results from both feeding and toxins; heavy infestations can cause loss of tree vigor, defoliation, splitting of twigs and branches, death & fruit quality and production decrease; discussion of 5 different lists of scale pests of citrus prepared from 1948 to 1986.

Rose, M. & DeBach, P. 1990. 3.6.2 Foreign Exploration and Importation of Natural Enemies. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 417-431; ill. (World Crop Pests.)

Preparation, equipment, searching, handling & shipping techniques, selection of colonization sites; examples of projects are given.

Rose, M. & DeBach, P. 1990. 3.6.4 Conservation of Natural Enemies. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 461-472. (World Crop Pests.)

Citrus in California is used as a basis for discussing conservation; two topics are covered--mitigation of adverse effects of pesticides and mitigation of adverse biotic factors.

Rosen, D. 1990. 3.6.1 Biological Control: Introduction. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 413-415. (World Crop Pests.)

Diaspididae are likely candidates for biological control because they are sedentary, occur in colonies, and have fairly stable populations; their natural enemies include predators, pathogens, endoparasites, and ectoparasites; methodology of biocontrol; successful projects involving Diaspididae.

Rosen, D. 1990. 3.6.6 Biological Control: Selected Case Histories. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 497-505. (World Crop Pests.)

Review of 12 examples of biological control of scale pests; attempt at control of Aonidiella aurantii unsuccessful.

Rosen, D. & DeBach, P. 1990. 2.3 Ectoparasites. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 99-120; ill. (World Crop Pests.)

Summary of ectoparasites of Diaspididae; taxonomy, biology, distribution, ecology; majority of coverage on Aphytis (Aphelinidae) because that is the genus for which information exists; key to 6 genera of Aphelinidae which are closely related.

Rosenheim, J.A., Hoy, M.A., Gorden, J. & Stewart, J.R. 1989. Selecting for insecticide resistance in a California red scale parasitoid. California Agriculture 43(1):17-18; ill.

Natural insecticide resistance of Aphytis melinus, a biological control agent of Aonidiella aurantii, was augmented in the laboratory, suggesting that selected strains may be able to survive in citrus groves sprayed with carbaryl.

Rossler, Y. & Rosen, D. 1990. 3.8.2 A Case History: IPM in Citrus in Israel. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 519-526. (World Crop Pests.)

25 insects and 5 mite species are pests of citrus in Israel; an IPM program has been developed which consists of biological control, use of selective pesticides or selective modes of application, monitoring pest populations as a basis for chemical intervention, post-harvest treatment of fruit for the correction of cosmetic damage; involvement of five species of Diaspididae: Aonidiella aurantii, Chrysomphalus aonidum, Lepidosaphes beckii, Parlatoria pergandii & P. cinerea.

Le Ru, B. 1988. The role of Neozygites fumosa in regulating cassava mealybug populations. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 212-215. (In English)

P. manihoti is major pest of Manihot esculenta; has caused crop loss of around 30%; in Brazzaville, an eroded savannah, populations of this sp. reach maximal level at end of dry season; populations very low during rainy season; forceful tropical rainfall eliminates diseased fraction of the population.

Le Ru, B. & Iziquel, Y. 1988. Evaluation of the mechanical effect of rain on the dynamics of populations of the cassava mealybug, Phenacoccus manihoti, with the help of a rain machine. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 1-18. (In French)

Examines duration, frequency and intensity of rain, and condition of hosts.

Le Ru, B. & Iziquel, Y. 1988. New data on the spread of the pathogen Neozygites fumosa on the cassava mealybug, Phenacoccus manihoti. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 217-238. (In French, English abstract)

This pathogen spreads very fast; two distinct stages are identified: a building up stage which correlates with size and structure of colonies, and a typically epizootic stage which is not dependant on size or structure of colonies; evolution of the epizootic appears to be more closely related to rainfall regularity than with the amount of rain; significance of the time during which the canopy remains wet is demonstrated for the first time; density of conidia in the air is positively correlated with the level of infection of P. manihoti population.

Le Ru, B. & Iziquel, Y. 1990. New observations on the epizootiology of Neozygites fumosa in populations of the cassava mealybug Phenacoccus manihoti. (Nouvelles donnees sur le deroulement de la mycose a Neozygites fumosa sur la cochenille du manioc Phenacoccus manihoti.) (Congo) Entomaphaga 35(2):173-183. (In French, English abstract)

This disease spreads rapidly in two distinct phases; first phase, implantation, correlates with size and structure of host colonies; second phase, epizootic phase, relates to frequency of rainfall; conditions highly favorable for second phase when air humidity is greater than 90% for at least 5 hours per day, consistently.

Le Ru, B., Iziquel, Y., Kiyindou, A., Biassangama, A., Fabres, G. & Nenon, J.-P. 1988. (La cochenille du manioc et sa biocenose au Congo.) The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 238 pp. (In French, English abstract)

Collection of papers relating to: variations in the quantity of the pest in relation to environmental factors (entomophagous, pathogene, rainfall); biological charcateristics of exotic parasitoid E. lopezi and its impact on the Phenacoccus manihoti; epidemiology of the Entomophthorale Neozygites fumosa; evolution of the entomophagous complex.

Le Ru, B., Iziquel, Y., Biassangama, A. & Kiyindou, A. 1988. The establishment of the cassava mealybug before the introduction of Epidinocarsis lopezi, American encyrtid, to the Congo in 1982, and after. (La cochenille du manioc et sa biocenose au Congo.) In B. Le Ru, Y. Iziquel, A. Kiyindou, A. Biassangama, Gerard Fabres & J.-P. Nenon. The cassava mealybug and its ecology in the Congo: 1985-1987. Paris, France: Orstom. 1-18. (In French, English abstract)

Pest of Manihot esculenta; the population has remained constant for 9 years; presence most obvious at the beginning of the rainy season; predators include: Lestodiplosis, Allograpta nasuta, Allobacha eclara, Cardiasthetus exiguus, Exochomus flaviventris & Hyperaspis senegalensis hottentotta; parasite: Epidinocarsis lopezi; pathogen: Neozygites fumosa.

Russell, L.M. & Stoetzel, M.B. 1991. Inquilines in egg nests of periodical cicadas (Homoptera: Cicadidae). Proceedings of the Entomological Society of Washington 93(2):480-488; ill.

Egg nests of brood X of 17-year periodical cicadas (Magicicada spp.) of 1987 were occupied by four orders of Insecta. Species of Pseudococcidae and Eriococcidae developed from eggs to adults, etc. were found. Mealybugs entered nests where unhatched cicada eggs and dead cicada nymphs were present. Scale spp. discussed include: Planococcus japonicus, P. azaleae, Crisicoccus azaleae and Gossyparia spuria.

Russo, A. 1985-89. Check-list of scale insects (Homoptera: Coccoidea) reported for Sicilian fauna. Phytophaga :147-162.

114 species listed from 11 families.

Russo, A. & Longo, S. 1990. A new species of Scythia Kiritshenko (Homoptera: Coccoidea: Coccidae) from Mount Etna, Italy. Israel Journal of Entomology 24:1-4.

Adult female soft scale insect collected on Festuca circummediterranea; description.

Russo, A. & Siscaro, G. 1989. Biological and ethological observations on Insulaspis gloverii (Packard) (Homoptera: Coccoideá: Diaspididae) in Eastern Sicily and Calabria. (Rilievi bio-etologici su Insulaspis gloverii (Packard) (Homoptera: Coccoidea: Diaspididae) in Sicilia orientale e Calabria.) Tecnica Agricola 41(4):5-11. (In Italian, English abstract)

Biology; discussion of natural enemies include Encarsia citrina, Aphytis sp. and A. herndoni.

Russo, A., Siscaro, G., Bottino, S. & D'Amico, M. 1987. Preliminary results of "fitoatrici" against Ceroplastes rusci on lemon with new fixed placement spraying equipment. (Risultati preliminari di trattamenti fitoatrici contro Ceroplastes rusci (L.) su limone con aun nuova attrezzatura distributiva a postazione fissa.) L'informatore Agrario 22:79-81; ill. (In Italian)

Comparison of two methods of spraying chemicals for control.

Sadof, C.S. & Raupp, M.J. 1991. Effect of variegation in Euonymus japonica var. aureus on two phloem feeding insects, Unaspis euonymi (Homoptera: Diaspididae) and Aphis fabae (Homoptera: Aphididae). Environmental Entomology 20(1):83-89.

Behavior and performance of a wide range of phloem feeding insects have been linked to the transport of nitrogen in plants; this research focussed primarily on aphids but two scale species were mentioned: Fiorinia externa and Icerya seychellarum.

Samson, R.A. 1989. New species of Torrubiella (Ascomycotina: Clavicipitales) on insects from Ghana. Studies in Mycology (31):123-132; ill.

3 new species described and illustrated. Torrubiella sphaerospora was collected on Coccidae.

Sao Paulo de Souza, S. 1988. Population trends of Mytilococcus beckii (Newman, 1869) (Homoptera, Diaspididae) in Pera, Valencia and Mandarina orange orchards, in Guaiba, state of Rio Grande do Sul. (Flutuacao populacional de Mytilococcus beckii (Newman, 1869) (Homoptera, Diaspididae) em Pomares de Laranjeiras Pera, Valencia e Mandarina, no Municipio de Guaiba, Estado do Rio Grande do Sul.) (Brazil) Arq. Univ Fed Rural 11(1-2):51-58. (In Portuguese, English abstract)

Population peaks occurred in November-December and May-June; the late Valencia cultivar was more infested than the others; climatic factors and natural enemies influential.

Schaefer, C.W. & Kosztarab, M. 1991. Systematics of insects and arachnids: status, problems, and needs in North America. American Entomologist (Winter):211-216.

Definition of taxonomy; loss of biological diversity; inventory of work yet to be accomplished in systematics; recommended strategies for future systematics work.

Schaffer, B. & Mason, L.J. 1990. Effects of scale insect herbivory and shading on net gas exchange and growth of a subtropical tree species (Guaiacum sanctum L.). Oecologia 84(4):468-473.

Toumeyella sp. feeds exclusively on Guaiacum sanctum, which is indigenous to the Caribbean region, including Lignumvitae Key State Botanical Site, a protected habitat. Controlling this scale species could prevent extinction of this rare tree.

Schreiner, I. Biological control introductions in the Caroline and Marshall Islands. 1989. In Proceedings of the Hawaiian Entomological Society. Honolulu, Hawaii: Nov. 30, 1989. 57-69.

Successful introductions include coccinellids for control of Icerya spp. and Aspidiotus destructor.

Schultheiss, F., Baumgartner, J.U., Delucchi, V. & Gutierrez, A.P. 1991. The influence of the cassava mealybug, Phenacoccus manihoti Mat.-Ferr. (Hom., Pseudococcidae) on yield formation of cassava, Manihot esculenta Crantz. Journal of Applied Entomology 111(2):155-165. (In English, German abstract)

This species is a dry season pest of cassava. Peak CM population densities varied greatly due to plant size at the time of infestation, duration of infestation, and mortality from the introduced parasitoid Epidinocarsis lopezi. CM feeding reduced new leaf production and assimilation and allocation of dry matter to storage roots. Severely infested plants lost between 9% and 46% during the dry season compared to CM-free plants.

Schultz, P.B. 1990. Forecasting flight activity of native parasitoids of Oak Lecanium (Homoptera: Coccidae). Journal of Entomological Science 25(4):622-627.

Flight activity of major parasitoids of Parthenolecanium quercifex was monitored on Quercus phellos.

Shah, N.K., Belavadi, V.V. & Pal, R.N. 1989. Occurrence of the scale insect Ceroplastodes sp. (Homoptera: Coccidae) on Sesbania. (India) Journal of the Andaman Science Association 5(1):86.

Sesbania is used as cattle feed to increase milk yield; this is the first record of this scale species attacking Sesbania; also on ber, fig, drumstick, guava, Ocimum and legumes.

Sheffer, B.J. & Williams, M.L. 1987. Factors influencing scale insect populations in southern pine monocultures. Florida Entomologist 70(1):65-70. (In English, Spanish abstract)

Factors include weather, host plants, pesticides usage, and edaphic conditions; effects of chemical control which reduces populations of natural enemies attacking scale insects; effects of contiguous plantings of limited varieties of pine clones on both scale populations and scale parasitoid/predator diversity; influence of fertilization on increasing scale insect numbers; eight scale spp. mentioned as examples.

Shidrawi, G.R. 1990. A WHO global programme for monitoring vector resistance to pesticides. WHO Bulletin OMS 68(4):403-408.

Resistance to pesticides has become the most important technical problem facing pest control programs; over $500 million are spent annually on pesticides; resistance to the insecticide lime sulfur was first noted in the San Jose scale insect, Aspidiotus perniciosus in 1905; this monitoring program is discussed.

Singh, K., Sharma, V.K. & Shant, P.S. 1988. Efficacy of banding materials and insecticidal foliar sprays against mango mealy bug, Drosicha mangiferae Green (Margarodidae: Homoptera). (India) Pesticides 22(10):26-27.

Results indicate high degree of success of banding to control this species on mango.

Singh, P. & Ahmed, M. 1989. A handy guide on insect pests of Tamarind and their control. (India) Indian Forester 115(9):673-679.

Tamarindus indica (Leguminosae) is indigenous to dry savannah of tropical Africa and grown in southeast Asia, Egypt, Pakistan, India, Sri Lanka, Bangladesh and Burma. It is host to more than 40 insect species in India including about 15 scale species.

Smitley, D.R., Davis, T.W., Kearns, K.A. & Stevens, C.A. 1991. Yew: Taxus x media "densiformis"; Fletcher scale; Parthenolecanium fletcheri (Cockerell). In Insecticide and Acaricide Tests. Thomas, J. H. (Ed.) Lanham, Maryland: Entomological Society of America. Vol. 16; p. 265.

Chemical control described.

Speight, M.R. 1991. The impact of leaf-feeding by nymphs of the horse chestnut scale Pulvinaria regalis Canard (Hem., Coccidae), on young host trees. Journal of Applied Entomology 112:389-399. (In English, German abstract)

Sycamores (Acer pseudoplatanus) exhibited dramatic reductions in leader, lateral and bottom shoot elongation in the presence of Pulvinaria nymphs; however, neither limes (Tilia cordata, T. europea, T. platyphyllos) or horse chestnuts (Acer pseudoplatanus) showed significant changes, although data for limes qualitatively suggested increased growth when infested; diameter growth was unaffected; all three host tree species suffered significant reductions in root dry weight biomass when infested.

Srivastava, R.P. & Fasih, M. 1988. Natural occurrence of Beauveria bassiana, an entomogenous fungus on mango mealy bug, Drosicha mangiferae Green. Indian Journal of Plant Pathology 6(1):8-10; ill.

This important entomogenous fungus recorded for the first time on mango mealybug; symptoms described; pathogenicity tests conducted using two methods.

Starnes, H.N. 1897. The San Jose and other scales in Georgia. Bulletin (Georgia Experiment Station) (36):31 pp.; ill.

Origin, introduction, distribution, description, life history, damage, natural enemies, and chemical control of Aspidiotus perniciosus Comstock. 12 additional scales discussed.

Stimmel, J.F. 1991. Cottony Camellia scale/cottony taxus scale, Pulvinaria floccifera (Westwood). Regulatory Horticulture 17(2):21-22; ill. (Entomology Circular No. 146, PA Dept. Agric., Bureau of Plant Industry.)

Field description, hosts, life history, damage & chemical control.

Stimmel, J.F. 1991. "New" scale on Scotch Pine. Regulatory Horticulture 17(2):7-8.

Striped pine scale or Toumeyella pini briefly described and compared to T. parvicornis.

Sugonjaev, E.S. 1989. A new species of the genus Blastothrixs Mayr (Homoptera, Encyrtidae) from Japan. Entomologicheskoe obozrenie (Entomological Review) 68(1):178-179; ill. (In Russian, English abstract)

New species (B. kuwanai) described briefly; from coccid, Eulecanium kunoense.

Sullivan, D.J., Castillo, J.A. & Bellotti, A.C. 1991. Comparative biology of six species of Coccinellid beetles (Coleoptera: Coccinellidae) predaceous on the mealybug, Phenacoccus herreni (Homoptera: Pseudococcidae), a pest of cassava in Colombia, South America. Environmental Entomology 20(2):685-689; ill.

Pest of Manihot esculenta; comparisons of adult coloration, sites of oviposition and pupation, larval feeding behavior, wax production, developmental times, sex ratios and potential for use in biological control programs of coccinellid beetles in South America and Africa studied.

Suomi, D.A. 1990. Scale insects on ornamentals. Extension Bulletin (Washington State Univ.) (EB 1552):24 pp.

Discusses 12 species; hosts; damage; lifecycle; monitoring; chemical control.

Suris, M. & Castillo, N. 1987. Variations in Diaspidid distribution according to infested organ and citrus variety in Matanzas Province. (Variaciones en la distribucion de diaspididos segun variedad y organo infestado de citrico en la provincia Matanzas.) (Cuba) Revista de Proteccion Vegetal 2(1):27-31. (In Spanish, English abstract)

9 genera from 2 families (Coccidae and Diaspididae) found; community structure exists which avoids interspecific competition.

Symons, T.B. & Weldon, G.P. 1907. Spraying for San Jose scale. Bulletin (Maryland Agricultural Experiment Station) (123):139-152; ill.

Aspidiotus perniciosus; common on fruit trees; chemical treatment trials.

Symons, T.B. & Cory, E.N. 1910. the Terrapin scale. Bulletin (Maryland Agricultural Experiment Station) (149):83-92.

Lecanium nigrofasciatum; history of occurrence; distribution in Maryland; description of damage; life history; hosts include peach, Crataegus, Carolina poplar, olive, Vaccinium, Brumelia and spice bush; natural enemies include Chalcidoidea, Coccophagus lecanii, Aphycus stomachosus, Encyrtus, Anagyrus nublipennis, Coccophagus cinguliventris, C. longifasciatus and Chilocorus bivulnerus; chemical control.

Tait, S.M., Dahlsten, D.L., Gill, R.J. & Doyen, J.T. 1990. Life history of the incense cedar scale, Xylococculus macrocarpae (Homoptera: Margarodidae), on incense cedar in California with a description of the larvae of one of its common predators Eronyxa expansus Van Dyke (Coleoptera: Trogositidae). Hilgardia 58(2):19 pp.; ill.

Biology of this species on Calocedrus decurrens in California at 1200 to 1550 m elevation; most common prey during winter months by birds; also Parechtrodryinus xylococculi and Mesopolobus sp.

Takagi, M. & Ogata, T. 1990. Reproductive potential of Aphytis yanonensis DeBach & Rosen and Coccobius fulvus (Compere & Annecke) (Hymenoptera: Aphelinidae), parasitoids of Unaspis yanonensis (Kuwana) (Homoptera: Diaspididae). (Japan) Appl. Entomol. Zool. 25(3):407-408.

These parasitoids were successfully introduced from China into Japan as biological control agents of the arrowhead scale, one of the most important citrus pests in Japan.

Takagi, S. 1988. A possible case of site-caused polymorphism in Aulacaspis (Homoptera: Coccoidea: Diaspididae). (Japan) Insecta Matsumurana 39:49-63; ill.

Remarkably different forms of Aulacaspis, collected in Nepal on the twigs and leaves of Acer oblongum are referred to A. ligulata, new sp.; presents case of variation caused by feeding site.

Tatara, A. 1987. Spatial distribution of four homopterous pests in an uncontrolled satsuma mandarin grove at Shimizu, Shizuoka prefecture, with special reference to the factor in the outbreak of two of them, citrus cottony scale and citrus whitefly. Bulletin (Shizuoka Citrus Experiment Station) (23):15-29. (In Japanese, English abstract)

Aggregated distribution of Pulvinaria aurantii (Chloropulvinaria aurantii) shown; natural enemies; decline of Unaspis yanonensis due to parasitoids Aphytis yanonensis and Coccobius fulvus may have allowed the increase in these pests; also, low rate of pathogenicity of entomogenous fungi.

Terry, L.I. & Edwards, G.J. 1989. Efficacy of densitometric and multispectral techniques for monitoring infestations of citrus snow scale on citrus bark. Photogrammetric Engineering & Remote Sensing 55(10):1471-1475.

Insecticides and parasties released for control of Unaspis citri must be routinely monitored in citrus orchards. Several analytic techniques used in aerial and multispectral photography were adapted to assess their ability to distinguish between various CSS morphs on citrus trees. Various film and filter combinations tried. Males and crawlers were easily distinguished under most scenarios. Live and dead males were separable under particular film and filter combinations, but no density differences were found between live and dead females. Therefore, these techniques do not seem reliable for this purpose.

Thompson, L.C. & Colvin, R.J. 1990. Biological notes on the mealybug Dysmicoccus obesus (Homoptera: Pseudococcidae) on Loblolly pine in southern Arkansas. Journal of Entomological Science 25(1):89-98.

Found on bark scales of Pinus taeda; also on Pinus virgiana; associated with Crematogaster ants.

Ujiye, T., Takagi, S., Kashio, T. & Fujii, H. 1988. Release, establishment and dispersion of Aphytis yanonensis and Coccobius fulvus (Hymenoptera: Aphelinidae), the introduced parasitoids of the arrowhead scale, Unaspis yanonensis (Hemiptera: Diaspididae) in several citrus growing areas of Kyusyu. Bulletin of the Fruit Tree Research Station 10:77-88. (In Japanese, English abstract)

These two parasitoid species introduced into various regions of Japan from China for biological control; surveys monitored their establishment; some success but not completely; failures due to insecticide spray, death of host plants just after release, and size of orchard area.

Umeh, E.N. 1990. Exochomus troberti Mulsant (Coleoptera: Coccinellidae): a predator of cassava mealybug, Phenacoccus manihoti Mat-Ferr (Homptera: Pseudococcidae) in southeastern Nigeria. Insect Science and its Application 11(2):189-195. (In English, French abstract)

Populations of this predator and its host were monitored over three years.

Upson, T.M. 1991. Biological control at the Royal Botanic Gardens, Kew. (Great Britain) Professional Horticulture 5(1):10-14.

Among examples given of successful biological control agents are Cryptolaemus montrouzieri for Pseudococcus obscurus on Aloe, Haworthia and Gasteria; and Aphidoletes aphidomyza and Metaphycus helvolus for Coccus hesperidum.

Van Alphen, J.J. M., Kraaijeveld, A.R. & Ren, X.C. 1990. A comparison of Epidinocarsis lopezi and E. diversicornis: a possible explanation for the failed introduction of Epidinocarsis diversicornis against cassava mealybug Phenacocus manihoti into Africa. Med. Fac. Landbouww. Rijksuniv. Gent 55(2a): 276-287.

Two species of Epidinocarsis have been introduced from South America into Africa as biological control agents against Phenacoccus manihoti; E. diversicornis could not establish itself in a community where E. lopezi is already present; sequence of release of natural enemies can be an important factor in determining the number of natural enemies ultimately coexisting.

van der Meiracker, R.A. F., Hammond, W.N. O. & van Alphen, J.J. M. 1990. The role of kairomones in prey finding by Diomus sp. and Exochomus sp., two coccinellid predators of the cassava mealybug, Phenacoccus manihoti. Entomologia Experimentalis et Applicata 56(3):209-217. (In English, German abstract)

Searching behaviour of Diomus compared to Exochomus for Phenacoccus manihoti while on cassava leaves; also observed searching for Planococcus citri.

Van Dijken, M.J., Neuenschwander, P., Van Alphen, J.J. M. & Hammond, W.N. O. 1990. Interpretation of sex ratios in Epidinocarsis lopezi a parasitoid of the cassava mealybug Phenacoccus manihoti as found in cassava fields in Africa. Med. Fac. Landbouww. Rijksuniv. Gent 55(2a):417-426.

Sex ratio of parasitoid increases with host (Phenacoccus manihoti) density because the proportion of small hosts encountered in the field increases with increasing host density, small hosts are used for male production, and hosts are always accepted when encountered.

Van Dijken, M.J., Neuenschwander, P., Van Alphen, J.J. M. & Hammond, W.N. O. 1991. Sex ratios in field populations of Epidinocarsis lopezi, an exotic parasitoid of the cassava mealybug, in Africa. Ecological Entomology 16:233-240.

Sex ratio increases with host (Phenacoccus manihoti) density because proportion of small hosts encountered in the field increases with increasing host density, small hosts are used for male production, and hosts are always accepted when encountered.

Varshney, R.K. 1987. Some thoughts on the host-plants of Indian lac insects (Homoptera: Tachardiidae). In Proceedings of the 3rd Oriental Entomology Symposium, edited by N. R., Prabhu, V.K.K., Mohandas, N. & Karnavar, G.K. Brabhoo. University of Kerala, Kariavattom, India: February 21-24, 1984. 103 pp. Kerria sp. are known to thrive on more than 400 plants.

Vastrad, A.S., Lingappa, S., Goud, K.B. & Bhadragoudar, R.S. 1990. Some new hosts of lantana bug Orthezia insignis Browne (Hemiptera: Ortheziidae). (India) Entomon 15(1-2):127-130.

This species observed on 25 plants belonging to 17 families for the first time.

Vazquez, L.L. 1988. Organotropic relationship of Coccoids (Homoptera) in the coffee fields of Jibacoa, Villa Clara Province. (Relacion organotropica de Coccoideos (Homoptera) en la zona cafetalera de Jibacoa, Provincia Villa Clara.) (Cuba) Revista de Proteccion Vegetal 3(1):63-66. (In Spanish, English abstract)

Survey of scale species on coffee included Coccus viridis, Saissetia, S. oleae and Ischnaspis longirostris; C. viridis most damaging.

Venkataramiah, G.H. & Rehman, P.A. 1989. Ants associated with the mealybugs of coffee. Indian Coffee 43(90):13-14.

27 ant species have been recorded worldwide in association with Homoptera attacking coffee; 12 species recorded in India listed; benefits of association discussed.

Viggiani, G. 1990. 2.4 Endoparasites. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 121-132; ill. (World Crop Pests.)

[This chapter also called: 2.4.1 Aphelinidae.]

Review of the primary endoparasites of Diaspididae; taxonomy, biology, distribution, scale hosts; key to 8 genera for females and 7 for males.

Viggiani, G. 1990. 2.5 Hyperparasites. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 177-181; ill. (World Crop Pests.)

Review of known hyperparasites in the families Aphelinidae and Signiphoridae that attack Diaspididae; no key but some taxonomic characters given for genera; scale host genera and species mentioned when known.

Viggiani, G. 1990. Description of Metaphycus delucchii sp. nov. (Hymenoptera: Encyrtidae), parasitoid of Gossyparia spuria (Modeer) (Homoptera: Eriococcidae), with preliminary biological information. Bulletin de la Societe Entomologique Suisse 63:281-285; ill.

New species of parasitoid described; biology.

Vikberg, V. 1991. Diaspidiotus bavaricus Lindinger (Diaspididae) and Acanthococcus baldonensis Rasina (Eriococcidae) new to the Finnish fauna (Homoptera, Coccoidea). Entomol. Fennica 2(1):4.

D. bavaricus and A. baldonensis found on stems of Calluna vulgaris.

Vinson, S.B. 1990. 3.6.3.3. Potential for Semiochemical Manipulation of Beneficial Insects used to Control Scale Insects. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 453-459. (World Crop Pests.)

Review of previous work on semiochemicals (behavioral chemicals) and scale insect parasitoids; potential sources of semiochemicals; isolation and bioassays; potential for use.

Vranjic, J.A. & Gullan, P.J. 1990. The effect of a sap-sucking herbivore, Eriococcus coriaceus (Homoptera: Eriococcidae), on seedling growth and architecture in Eucalyptus blakelyi. (Australia) Oikos 59(2):157-162.

Root dry weight more affected than shoot dry weight; infested plants allocated proportionally more dry matter into leaves at the expense of root growth; almost half the leaves were contaminated with sooty moulds to some extent throughout the course of the infestation.

Waite, G.K. 1988. Biological control of Latania scale on avocados in south-east Queensland. (Australia) Queensland Journal of Agricultural amd Animal Sciences 45(2):165-167.

Hemiberlesia lataniae is cosmopolitan pest of various fruits and nuts including avocado, kiwifruit and macadamia; causes cosmetic problem for producers; natural enemies investigated for control: Aphytis proclia, Encarsia citrina, Signiphora flavella, S. perbauca, Chrysopa oblatis, Rhizobius satellus and Amblyseius.

Walde, S.J., Luck, R.F., Yu, D.S. & Murdoch, W.W. 1989. A refuge for red scale: the role of size-selectivity by a parasitoid wasp. Ecology 70(6):1700-1706.

A physical refuge (an area where mortality due to parasitism is very low) is populated mainly by small specimens; however, size-selectivity accounted for only about 10% of the observed difference in parasitism rate of Aonidiella aurantii by Aphytis melinus.

Wang, C.-M. & Su, T.-H. 1989. The effect of temperature on population parameters of the Latania scale, Hemiberlesia lataniae Signoret. (Taiwan) Chinese Journal of Biological Control 9(2):151-156. (In Chinese, English abstract)

Hemiberlesia lataniae reared on pumpkin at different temperatures; period of juvenile stage was inversely related to temperature; fecundity rate, net reproductive rate and finite growth rate also correlated with temperature.

Wang, T.-C. 1988. Homoptera: Coccoidea. In Insects of Mt. Namjagbarwa region of Xizang. Huang, F.-S. et al., Editors Beijing: Science Press. pp. 173-175. (In Chinese, English abstract)

Annotated list of Coccoidea species recorded from Namjagbarwa region, Xizang of China representing 12 genera and 12 species from 7 families; 9 genera and 9 species recorded for the first time from this region: Kuwania zeylanica, Antonina pretiosa, Asterococcus yunnanensis, Asterodiaspis liui, Cosmococcus erythrinae, Kermococcus roboris, Coccus mangiferae, Ceroplastodes cajani and Aulacaspis intermedius; hosts; distributions.

Williams, D.J. & Granara de Willink, M.C. 1992. Mealybugs of Central and South America. London, England: C.A.B. International. 635 pp.; ill.

Discusses 282 species and 49 genera of Pseudococcidae; 5 new genera and 62 new species described; keys; illustrations; distributions; hosts.

Williams, D.J. & Watson, G.W. 1990. The scale insects of the tropical South Pacific region. Pt. 3: The soft scales (Coccidae) and other families. London: CAB International Institute of Entomology. 267 pp.; ill.

Keys to 13 families, 42 genera, 81 species; 4 new genera, 15 new spp., 4 new combinations & 6 new synonymies proposed; covers Melanesia, Polynesia from Irian Jaya in the west to Easter Island in the east & Kiribati; list of host plants; history; economic importance; morphology; systematics.

Williams, J.R. & Greathead, D.J. 1990. 3.9.4 Sugar Cane. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 563-578. (World Crop Pests.)

Sugar cane is the only field crop which is seriously damaged by diaspidids; 21 species; those attacking leaves are not important, but those on stems become serious pests; biological control of Aulacaspis tegalensis, A. madiunensis, and Melanaspis glomerata.

Woolley, J.B. 1990. 2.4.3 Signiphoridae. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 167-176; ill. (World Crop Pests.)

Review of the Signiphoridae; taxonomy; key to 4 genera; biology; scale hosts are enumerated.

Wouters, J. & Verhecken, A. 1991. Potential taxonomic applications of H.P.L.C. analysis of coccoidea pigments (Homoptera: Sternorhyncha). Belg. Journal of Zoology 121(2):211-225.

High Performance Liquid Chromatography (HPLC) was applied to separate and identify the constituents of the pigments of scale insects; attempt to classify Kermes biblicus and K. palestiniensis; attempt to clarify relationship between K. vermilio and K. ballotae, living on the same plant species; search for complementary evidence for a suggested identity of Porphyrophora polonica and P. crithmi.

Xu, F. & Wu, D. 1989. Control of bamboo scale insects of intercropping rape in the bamboo forest to attract coccinellid beetles. Chinese Journal of Biological Control 5(3):pp. 117-119. (In Chinese, English abstract)

Nesticoccus sinensis and Rhizococcus transversus are two important pests of bamboo forests in southern Jiangsu. Oil seed rape was planted among the bamboo to attract aphids, mostly Brevicoryne brassicae which, in turn, attracted coccinellids, mostly Harmonia axyridis and H. obscurosignata. After rape harvest, the coccinellids dispersed onto the bamboo to prey on scales, which reduced scale population by 97-99%.

Yu, D.S., Luck, R.F. & Murdoch, W.W. 1990. Competition, resource partitioning and coexistence of an endoparasitoid Encarsia perniciosi and an ectoparasitoid Aphytis melinus of the California red scale. Ecological Entomology 15(4):469-480.

Encarsia parasitized all stages of Aonidiella aurantii but it preferred first and second instar scales; Aphytis melinus parasitized second and third instar females and second instar males but preferred third instar females; Encarsia did not distinguish between unparasitized hosts and those previously parasitized by Aphytis; Encarsia always outcompeted by Aphytis when both species parasitized the same host; Encarsia preferred scale on stems; Aphytis preferred scale on leaves and fruit.

Zahradnik, J. 1990. 3.9.9.1 Conifers. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 633-644. (World Crop Pests.)

38 species reviewed; information given is very sketchy for some species, but for others includes short description, notes on host plants, biology, predators, parasites, distribution & economic importance.

Zahradnik, J. 1990. 3.9.9.2 Other forests. In Armoured Scale Insects, Their Biology, Natural Enemies and Control, Vol. 4B. D. Rosen, ed. Amsterdam: Elsevier. p. 645-654; ill. (World Crop Pests.)

Host plants, biology, predators and parasites, distribution, and economic importance of 24 diaspidids of non-coniferous forest trees.

Zaman, M. 1989. Comparative efficacy of some insecticides in controlling San Jose scale on plum in Peshawar. Pakistan Journal of Scientific and Industrial Research 32(4):262-263.

Five chemical treatments tested on Quadraspidiotus perniciosus; the highest level of reinfestation occurred with deltamethrin + dimethoate.

Zou, J., Ou, Z. & Zhou, C.S. 1990. A survey on the parasites of chaff scale, Parlatoria pergandii (Hom.; Diaspididae) in Hunan. Chinese Journal of Biological Control 6(1):27-30. (In Chinese, English abstract)

Six hymenopterous parasites were found on this citrus pest; Aphytis hispanicus was recorded for the first time in this province; parasitization rate of this scale was relatively high in orchards with high humidity, fertile soil, and little insecticidal treatment; higher rate in spring than in autumn.